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Emil LEEB

General of the Artillery, Retired

Chief of Army Ordnance Office

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The tasks of the Army High Command in filling tactical and strategic requirements by technical developments of weapons, equipment and ammunition and by the mass production of these in the armament industry - as illustrated by organization, functions and method of operation of the Army Ordnance Office.

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INTRODUCTION

No source material was available for this work. The presentation is predicated upon memory.

The experiences gained and the evaluation of organizational matters, et cetera, will be set forth individually as the latter are discussed for the period covered by this report, or they will find mention in separate chapters. An over-all picture of the experiences will be presented in a separate chapter at the end.

Assistance has been rendered through written contributions by:

Major General, Dipl. Ing. * Beisswaenger, ret'd,

Last with the Office of Chief of Ordnance Proving 8.

Lieutenant General Willy Gimmler, ret'd,

Last with Office of Chief of Ordnance Proving 7.

Major General, Dipl. Ing. Hans Henrici, ret'd,

Last with Office of Chief of Division - Ammunition.

Colonel Karl Justrow, ret'd,

Last with Office of Chief of Acceptance.

Major General, Dipl. Ing. Kittel, ret'd,

Last with Office of Chief of Ordnance Development.

Lieutenant General, Dip. Ing. Wilhelm Phillips, ret'd,

Last with Office of Chief Division Weapons.

Ministerial Director, Dupl. Ing. Hermann Pollert, ret'd,

Last with Office of Chief Engineer.

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* Graduate (with that Academic Degree) of an Accredited Technical Institute.

Colonel Walter Reissinger, ret'd,

Last with Office of Chief of Staff.

Major General, Dipl. Ing. Dr. Ing. Fritz Stammbach,

Last with Office of Chief of Division - General Armed Forces and Combat Equipment.

A.) General.

1) Functions of the Army Ordnance Office.

The Army Ordnance Office was the central office for the technical development and the production of weapons, equipment and ammunition. As a rule, the requirements and the approval for these came from the General Army Office through its Ordnance Inspectors, who in turn were under the General Staff.

The functions presented themselves as these individual tasks:

a) Development of new weapons, equipment and ammunition.
(Development and proving).

b) Mass Procurement of weapons, equipment and ammunition.
(Industrial armament).

c) Technical Bases, including preparation and installation of the means for mass production in the industry.
(Chief Engineer)

d) Acceptance of weapons, equipment and ammunition produced.
(Acceptance)

The Army General Office in peace-time established the requirements of the necessary quantities of weapons, equipment and ammunition for the fiscal year, in time of war it established these requirements on monthly basis.

The Army Ordnance Office in the peace-time organization (until 8-31-39) was immediately subordinated to the ~~Supremem~~ Supreme Commander of the Army, in the war-time organization (after 9-1-39) it was under the Chief of Armament and Commander of the Replacement Training Army.

II) Demarcation in Point of Time

With the creation of the Office of the Reichsminister for Armament and Ammunition in March 1940, and after the fall of 1943, for Armament and War Production, the responsibility for non-military matters passed from the Army Ordnance Office to the newly created Office of the Reichsminister.

For this reason an over-all distinction must be made between the activities from 1938 to 1940 and those from 1940 to 1945.

III) Conditions of War Economy

1938 - 1940

"The economy is still one of peace, of connections, combinations and interests in private industry; there is as yet no organization of war economy as such. The cooperation between the Armed Forces and the industry is based on the ~~relations~~ relation characterizing private enterprise, the relation between business and customer." However, the appointment of an Administrator for Chemistry and for motorized equipment indicats that the State is beginning to take a leading hand.

The connection with the industry is maintained by the Armed Forces Economy and Armament Office and the Armament Inspectors within this office.

"A clear demarcation of responsibilities as between the party placing the orders and that accepting the items ordered is possible; there exists a purely factual basis for cooperation.

The combinations characterizing private enterprise in times of peace make it difficult for the Military to fully benefit from and utilize the potential."

1940-1945

"The heretofore existing connections, combinations and interests in the economic picture are given an ever-increasing uniformity of orientation by State and Party." The war economy organizes itself, finally in the form of commissions (development), committees (mass production) and "rings" (Halbzeuge) according to weapons, ammunition, motorized vehicles, et cetera.

The Reichsminister for Ballistics and Ammunition gradually takes over an ever-growing portion of the tasks and responsibilities resting with the Armed Forces and the Army. Into his department he incorporates large portions of the Armed Forces Economy and Armament Office and of the Armament Inspection. The Army Ordnance Office gradually adapts its organization to that of the war economy.

Thus the responsibility of the Minister becomes ever more apparent, while to all appearances the responsibilities of the Army remain the same and the opportunities for the Military to influence directly the War Economy are gradually reduced.

"The manner in which the War Economy is organized and orientated offers ever increasing possibilities for benefit from and full utilization of the war potential, however, the Military still is without the opportunity of being acquainted with and of having insight into the war economy, although this opportunity is essential for the performance of its tasks.

The ever growing scope of the functions makes for a shift of the responsibility downward."

In the matter of personnel, connections begin to appear between individuals attached to the Army Ordnance Office and others in the Office of the Reichsminister for Ballistics and Ammunition, or for Armament and War Production.

By reason of the increasing influence of the bomb-war and the operations in the rearward areas, endeavors were made to establish production centers which from the middle of 1944 had ~~their~~ it's effect on the location of offices for the Army Ordnance Office.

IV) Influence of Top Organization

Beyond matters of development, the Army Ordnance Office had no determining influence on the introduction or the nonacceptance of new weapons, et cetera, nor on essential changes for these. Instead, these decisions were made by authorities which were possibly inclined to pay more attention to matters of organization and training or to the requirements of the front at any given time, then to well rounded technical development and perfection, or to economic possibilities and matters of construction by the manufacturers.

In essential decisions the personality of Hitler as the Supreme Commander of the Armed Forces with his individuality and his relation to the Army, played an important part.

1938 - 1940

"At this time the Supreme Commander of the Armed Forces still had a certain confidence in the leadership of the Army. With the exercise of a certain personal restraint, the cooperation moved in time-proven channels. The 'expert' still has something to say. The final responsibility for the execution of the tasks still rests solely with the Military. There is as yet no influence being exerted by any third party of any consequence. Within the Armed Forces the Army is still foremost; however, the appointments of Administrators are beginning to make themselves felt. Strong repercussions, as a result of the 100,000-man Army are still apparent."

Only the spring of 1940 brings the order for the execution of mass production plans as prepared for case of war.

II.

1940 - 1945

"The Supreme Commander of the Armed Forces begins to manifest increasing distrust and begins to take a direct hand in technical matters. More and more, the 'revolutionary element' comes into the matter of cooperation. Substitute measures begin to be more and more the rule, the 'expert' is under suspicion and amateurism is raised on a pedestal. There is a growing influence exerted by the Party; more and more, the Military is forced to safeguard itself against usurpations by the Party. We are sitting on at least two saddles simultaneously."

Only with the end of 1944, which marks the appointment of the last Chief of Army (Armed Forces) Armament, does a more pronounced consideration of the opinion in the Army Ordnance Office once more become manifest.

B.) Organization

For the purpose of performing its functions the Army Ordnance Office was organized as follows:

	Beginning 1938	according to Appendix I
	After 7-1-40	" " " II
Appendix I-IV	Beginning 1944	" " " III

For suborganization of Sections see Appendix IV.

The creation of the Office of the Reichsminister for Ballistics and Ammunition (March 1940) made it necessary to render the organization of the Office more flexible and to adapt it to the organization of the former. For this reason the Division of Industrial Armament was dissolved in return for which the new Divisions for Industrial Armament "Weapons and Equipment" and "Ammunition".

Appendix II. were given independence to such a degree that they were able to effect all dealings with the Reichsminister for Ballistics and Ammunition under their own authority. Only when particular difficulties occurred or when the presentation of especially important matters was required was the office as such to be brought into the picture.

The economic, et cetera, tasks concerning both the Industrial Armament, Weapons and Equipment and Ammunition, as well as the remaining Divisions which heretofore had been performed, at least in part, by Industrial Armament, were taken over by the newly created Division of Central Functions.

In this manner the Chief of that Division was in a position to directly influence Industrial Armament (Weapons and Equipment and Ammunition) and to have a voice in gneral questions concerning the office. This arrangement made for a smaller staff of the Office itself, the functions of which could be confined to administratige tasks.

In former times the Research Section was under Ordnance Proving. For personal reasons, it was made independent (Appendix I and II). This solution did not prove satisfactory, for which reason it was in 1944 reincorporated into the Division of Development and Proving.*

The functional scope of the Division of Development and Proving (11 Sections) embraced the entire field of the Ordnance Office, including captured materiel, equipment and ammunition. It gradually became apparent that one man was not enough for this large field which in 1942, for instance, comprised more than 4,000 orders for development. Moreover, it became necessary to make for increased concentration of the authorities in the matter of ammunition.

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* Whether this solution was better than an incorporation into the Office of the Chief Engineer may remain a moot question.

This led in 1943 to the creation of the Division of Ballistics and Ammunition within the field of Development and Proving. In order to safeguard the connection with Weapons and Equipment, and because a different organization was not to be obtained from the Chief of Armament, Ordnance Proving, Ballistics and Ammunition, remained in certain technical and personnel matters under the Chief of Development and Proving (Weapons and Equipment). App. III

C.) Functions of the Individual Divisions

1) Army Ordnance Office - Division of Central Functions

The activities of the Division of Central Functions extended to all tasks of an economic or organizational nature which required a uniform administration or work for the over-all scope of the office. These include primarily matters of internal organization of the office, including a continued budget for personnel, other matters of the budget, matters of contract, examinations of bids and judicial matters (staffed by lawyers and national economists, in addition there were available for individual cases the legal talents of the Army High Command), of financial matters (including foreign exchange, appropriations which were made to Army Ordnance Office, for Budget of the Army (in Army General Office, later Chief of Armament and Commander of Replacement Training Army), of recording sketches and drawings, production material (printing, storing and dissemination of technical instructions); furthermore, the dealings with the Field Offices of the Economy and Armament Office in the Supreme Command of the Armed Forces (Armament inspections) and with the Offices in France, Italy, Hungary and Roumania.

Added to these was the work on all questions concerning Montanindustrie G.m.b.H. (see Chapter C/IV).

In 1943 the list of tasks was further increased by that of supervising the least possible consumption of all kinds of raw and scarce materials, as well as the development of new equipment, especially, matters of mass production. The development of production methods effecting a saving of raw and scarce materials was brought about in cooperation with the Chief Engineer of Ordnance Proving and Division of Central Functions.

The purpose was to so coordinate the work on questions concerning several divisions that the decisions by the Chief of the Office would be so prepared as to obviate time consuming conferences.

11) Army Ordnance Office - Division of Development and Proving

The requirement in the field of Development and Proving for New Weapons, Ammunition and Equipment was referred to Ordnance Proving by Weapon Inspections which frequently in turn would be prompted by the men working in the field of Development and Proving.

Suggestions from the troops, especially for improvements in individual instances, came either through ordinary channels or by way of a clearing station~~s~~, while the suggestions on the part of the industry would be made either directly or through the Office of the Reichsminister for Ballistics and Ammunition, later through Armament and War Production. Ordnance Proving was also in charge of the entire field of Army technical development in foreign countries.

The above mentioned requirements were translated into corresponding technical ones for development by the various concerns within the industry, the development being furthered under the guidance of the Army Ordnance Office in close cooperation with the former. "The examination of suggestions took place with due regard for the following points:

Functional safety,
Simplified production,
Employment of Materials of lesser qualities,
Increased efficiancy of equipment,
Basic Innovations (inventor)"

After thorough proving of the items produced, the equipment, et cetera was demonstrated to Weapon Inspections for their final decision; the necessary expert opinion was submitted at the same time. This, as a rule, was followed by either simple or extended practical tests by troops. The further development then lay in the hands of Weapon Inspections (General Army Office and Chief of Armament and Commander of Replacement Training Army). It was the duty of these agencies in important questions to obtain the decision from the Army High Command or from the Supreme~~s~~ Commander of the Armed Forces. In time of war a thorough proving could not always be made. In many instances abbreviated tests by the troops had to be sufficient.

In order to increase efficiency in development, it was a frequent practice to employ two firms in competition with one another. About the beginning of 1942 the Reichsminister for Ballistics and Ammunition decreed that because of the general situation in the field of production only one firm should be employed. In the long run however, this principle could not be upheld. The cost of development was compensated for in proportion to the accomplishments achieved. For purposes of testing and proving, the following proving grounds were available:

Kummersdorf (near Berlin) with 2 Ranges, each about 12 to 14 km. long, and one Driving Range with a length of from 2 to 3 km. with the necessary obstacles for motorized vehicles and tanks.

Sperenberg - Klausdorf (near Berlin) for ~~Pioneer~~ engineer equipment and Railroad ~~Pioneer~~ engineer Equipment.

Grulich in the Glatzer Mountains and Coast near Esbjerg for testing and firing tests for fortification installations.

Hillersleben (North of Magdeburg) with a Range about 28 km. long, 1 Driving Range with obstacles for horsedrawn vehicles and a sound Ranging test station.

Ruegenwalde (Hinterpommern) with a Range of approximately 150 km. along the coast line.

St. Johann in the Tirol for winter- and mountain proving of motorized vehicles and tanks.

Mittersill (Salzburger Country) for cabled transportation and cabled railways.

Berka near Eisenach for the proving of track laying vehicles in heavy soil.

Subtropical Proving took place in the summer of 1941 and 1942 about 100 km. south of Tripolis, 1943 in Greece.

Arctic Provings were made in the winter of 1941/1942 and 1943 in Norway in the vicinity of Roeris.

In Kummersdorf tests were made in heat chambers with temperatures up to 40 deg. C, in which Saraha sand storms could likewise be simulated; tests were also made in cold chambers down to 50 deg. C. below. Both types of chambers have provisions for firing tests from these chambers with live ammunition.

Ordnance Proving had charge of working on and developing technical regulations regarding our own weapons and captured ones, as well as captured ammunition and equipment; and Ordnance Proving also cooperated in developing the firing regulations of the General Office of ~~the~~ Army (Weapon Inspections, in time of war -- [illegible] ~~Weapon~~ Sections).

The development and proving of anti-aircraft weapons, ammunition and equipment lay in the hands of Division Anti-Aircraft of the Air Force. In the beginning this agency was in some degree subordinated to the Army Ordnance Office, however, in the course of time this relation of subordination was gradually loosened by the Air Force and finally shriveled to a state of loose cooperation between the two.

The proving of captured weapons, ammunition and equipment from Austria, Czechoslovakia, Poland, Denmark, Norway, France, Belgium, Holland, Yugoslavia, Greece, England, Russia, U.S.A., and later from Italy constituted a heavy burden, as did the matter of getting this materiel ready for our own use.

Army Ordnance demonstrated developments to the superior offices, the Commanders and Officers of the troops, to schools, as well as to representatives of friendly powers, and also those of foreign powers. (The latter activities upon orders by the Army High Command).

For the purpose of establishing better connections with the Front, the Office of "Higher Officers-Army Ordnance Office" (with a total number of four) was established about the middle of 1943, which were assigned to the Army troops in the East and in Italy (later one of these came to France from the East). They were subordinated to Ordnance Proving and had the following functions:

> To obtain all new weapons, ammunition and equipment of the enemy and to forward these to Ordnance Proving;
> to ascertain defects of our own weapons and ammunition;
> to bring about the introduction of new weapons and ammunition.

It is to be regretted that there was no connection in the matter of organization between Army Ordnance Office and the Front from the very beginning.

Up to the outbreak of the war the troops had weapon inspectors for continuous check on weapons, et cetera. The valuable reports from these agencies regarding the efficiency, and the defects of the weapons, et cetera, were conspicuously absent, none coming forth from either the Home Front, or the Front proper.

III) Ordnance - Chief Engineer

"Ordnance-Chief Engineer was in charge of all technical matters in the office as a whole. It was his duty to see that the latest accomplishments of technique received due consideration in matters of construction and mass production. Further, the Office was in charge of the ~~[illegible]~~ Technical Staff Offices and the rest of Technical personnel, both as regards the technical and personnel aspect.

With the aid of the sections under him, it was his duty to cooperate in the examination of sketches, drawings, standardization and production-technical material so far as possible, even during the early stages of development in order to provide adequate bases for production (drawings, specifications, operating means and instructive sketches. This function included the supervision of efficient utilization of materials, especially of scarce materials.

Three manufacturing sections for Halbzeug, Weapons and Equipment , and Ammunition were charged with preparing production technical requirements for the firms involved with reference to the quantities required by the Procurement sections (Industrial Armament, Weapons and Equipment, Ammunition) for mass production. These preparations embraced the planning of processing plants and providing these with installations, machinery, devices, instructions and tools. In close cooperation with the firms the objective was to accomplish the highest production efficiency that is to say, maximum output with a minimum of labor.

For the purpose of effecting a maximum economy of certain scarce materials, an Economy Commissar was temporarily appointed who was given the power to intercede/normally vested in the Chief of the Office and his subordinates. In this respect, the Commissar was subordinated to the Chief of the Office. For conditions ~~prevailing~~ prevailing after 1943, see Ordnance Proving.

1/ By order

IV) Ordnance - Industrial Armament

a) General

On the basis of requirements by General Army Office (Weapon Inspection) Industrial Armament prepared mass production and placed the orders with the industry. The technical basis for an individual order were ~~[illegible]~~ the drawings and technical specifications from the Chief Engineer which were prepared for each item separately. The object was to so formulate the technical specifications as to afford to the industry the widest possible margin of operation. All orders had in common the economic conditions of delivery. Filling the order and matters of procurement were governed by basic regulations from the Ordnance Office and the Treasury. Examination of bids and contracts was effected through the Economy Office and the Armament Office of the Army High Command, the decisions of which were binding upon the Office. Later, regulation of prices and examination of contracts were performed by the Reichsminister for Ballistics and Ammunition and by the Chief of Armament (Department of the Budget) respectively. Prior to the creation of the Office of the Reichsminister for Ballistics and Ammunition, the firms were selected by the Army Ordnance Office in direct co-operation with Armament Inspection and with the industry or with the Reich Economy Department (Reichswirtschaftsministerium). Whenever artisans or smaller industries were employed, the formation of delivery associations was favored. For military reasons, the orders were distributed as far as possible over the entire country. The necessary records of available firms and their capacities were kept by the Office.

E C

"This manner of preparing for mass production and of the placing of orders was practical for the purposes of peace-time and fully established its merit.

With the scarcity of production facilities as a result of the war, a centralized government administrative agency would have been required from the beginning, such as ~~it~~ was belatedly created in the Office of the Reichsminister for Ballistics and Ammunition. In a methodical preparation for war, it should have been provided within the scope of the Department of Economics (Wirtschaftsministerium)."

After the creation of the Office of the Reichsminister for Ballistics and Ammunition, the Office was increasingly bound by the directions of the Minister both in the selection of the firms for development and for mass production; the Minister had the responsibility for both. The placing of orders and the transmittal of technical material by the Army Ordnance Office to the industry remained unaffected.

"It was proper to transfer to the Reichsminister for Ballistics and Ammunition in cooperation with Industrial Armament as representative in military matters the distribution of orders within the industry with the assistance of committees and 'rings', as well as the supervision of over-all industrial performance and its unhampered activities in the case of special difficulties with the aid of the Armament Inspections. However, it would have been more efficient to leave the matter of order-supervision with Industrial Armament in direct connection with the industries' own organizations and the Armament Inspections as before. The close cooperation between Industrial Armament as the agency placing the orders and charged with military matters and the industry receiving the orders should not have been impeded to such a degree by interposing the Reichsminister for Armament and War Production as was the case toward the end of the war. In this manner many difficulties would have been avoided, especially in the adoption of new developments for mass production and in the execution of changes for equipment."

Industrial Armament in peace-time was charged with filling the orders within the limits of the means for one fiscal year; in war its function was to safeguard a monthly quota as determined by Army General Office (Weapon Inspection).

Inasmuch as the industry was frequently unable to satisfy the requirements with the available technical production facilities, the Supreme Command of the Army (Chief of Armament/Budget) extended credit or would make machinery available on a rental basis for replacements and, less frequently, for new installations. The matter of repaying the credit extended and of compensating for depreciation of machinery was regulated in special contracts. This assistance was made for the purpose of facilit~~i~~ating the production of weapons, equipment and ammunition as required. The Economy and Armament Office of the Armed Forces, Supreme Command, or in the alternative, the Reichsminister for Ballistics and Ammunition had to see to it that the necessary raw materials, raw products, as well as Halbzeuge and preparatory products, were available. Only in exceptional cases did the Ordnance Office within the High Command of the Army perform this function.

Since the requirements in case of mobilization (monthly quotas in time of war) far exceeded the technical and financial peace-time capacity of private industry, and since no guarantee could be made for correspondingly high activities in peace-time, the Army High Command (General Army Office/Budget and Army Ordnance Office) decided about 1933/34 to build government-owned factories. For various reasons, the cooperation of the industry in the building of these factories was solicited.

Industrial firms which as a rule would produce the item in question during peace-time were engaged as trustees for the building program in which capacity they received compensation. Once the factory had been built it was the custom to employ the same firm in a fiduciary capacity to operate the factory; such employment was regulated by contract.

By selecting various fiduciary firms within the same field for purposes of providing competition, the disadvantageous monopolistic position of individual firms was avoided. For the operation a special company had to be created; the Ordnance Office being represented in the Board of Directors. By contract that company was obligated to make certain payments in return for the lease of the government owned armament works; these payments included: The amount for the lease, the customary deductions for losses, depreciation, et cetera, before distribution of profit; a part of the profit, insofar as a claim had been established in a certain form.

The interests of the Army High Command was safeguarded in the dealings with these firms by another company "The Montanindustrie G.m.b.H." (Montan), a senior economic official of the Ordnance Office acting as Secretary. The functions of Montan were limited to purely administrative tasks. Any endeavor to form from this administration company a going concern was discouraged. The Board of Directors for this company was constituted by representatives of the Treasury, of the BudgetDivision of the Army Ordnance Office, or Chief of Armament and of the Army Ordnance Office. About 1942, representatives of industry were also invited to serve on this Board of Directors. The majority lay with the representatives of the Government. With the approval of the Supreme Accounting Office, the examination of Montan, as well as of the operating companies, was carried on by/a private examining company approved by the Government.

With the beginning of the fall of 1942, the influence on the part of the Reichsminister for Ballistics and Ammunition on Montan made itself felt more and more. As soon as purchasing plans corresponding to the agreements between the Chief of Armament and the Reichsminister for Armament and War Production would crystalize, the Army Ordnance Office would formulate technical requirements so as to enable the manufacturers to continue serving their original purpose after the sale. And these requirements were acknowledged. Beginning March 1945 Montan in its entirety was transferred to the Reichsminister for Armament and War Production with the approval of the newly appointed Chief for Army (Armed Forces) Armament~~)~~, Supreme Command of the Armed Forces). At times the Montan industry G.m.b.H. consisted of as many as ~~100~~ 120 factories and represented an invested capital of approximately four billions.

"The enlargement of industrial capacity by the Army Ordnance Office and the construction of government-owned works in times of peace proved to be absolutely necessary and successful within the limits of the means available. The principal salient points in the matter of planning were shown to be generally correct. In particular was it altogether proper to counteract by these very means monopolistic tentencies on the part of individual firms through a disinterested office. On the other hand, the State-owned organization had served its purpose in war for those works for which sufficient operation had been achieved on a long range; their reconversion to private ownership under certain conditions was practical."

Owing to the enlargement of the German sphere of influence, as a result of the war, procurement extended to Poland, France, Belgium, The Netherlands, Denmark, and Norway, as well as Italy, Hungary, Roumania and partially occupied regions of Russia where the orders were worked out through Armament Inspection, same as they were at home. The special position, as an organ of the Army, enjoyed in the beginning by the representative of the Army Ordnance Office in France, was gradually absorbed by the Reichsminister for Armament and War Production. The same was the case for the representative of the Ordnance Office in Italy (established in 1941) about the beginning of 1944~~)~~. The representatives of the Ordnance Office in Hungary and Roumania (serving simultaneously for Bulgaria) remained more or less independent to the end.

"For the purpose of obtaining a clear, uniform regulation and of safeguarding military requirements it would have been more practical to assign to the representatives of the Ordnance Office in Occupied Territories the same functions relative to procurement, as they were assigned to Industrial Armament in Germany, and to let the responsibility rest there with direct subordination to the Chief of the Army Ordnance Office, but with limited directive authority for the Chiefs of the Divisions in individual matters."

As a result of the very sudden requisition by Roumania of 100,000 rounds of ammunition for light field Howitzers, ~~for~~ Skoda-guns, in the fall of 1942, the production of which offered considerable difficulty due to the heavy burden already placed on the industry, the Army Ordnance Office, ~~in~~ about November 1942, submitted a document aimed at adapting the production of the principal calibers for Infantry, Artillery, and Anti-aircraft Artillery in Italy, Hungary and Roumania to the types used by the German Armed Forces. There was no time to act upon this suggestion in Italy, but in Hungary it was gradually realized. In Roumania, it was possible in May 1943 to conclude an agreement with the Secretary of War there by the terms of which delivery was provided of light field Howitzers-18-7.5 cm., anti-tank guns 40 and 3.7 cm., anti-aircraft 43 from Roumanian factories, these deliveries to begin in the fall of 1943 after certain individual parts, which were especially difficult to produce, had been delivered by Germany to Roumania. The execution of the agreement, however, was frustrated through difficulties arising in Roumania.

"Toward the end of the war, the political offices, especially those of the Gauleiter~~n~~, (Regional Administrators), were authorized to take a hand in matters of Armament production and distribution of industrial output, a fact which in numerous instances had considerable detrimental effect. It was the duty of the Army Ordnance Office and of the General Army Office to try to ameliorate these obviously disadvantageous conditions, but the efforts of these agencies did not always meet with success."

b) Ordnance - Industrial Armament, Weapons and Materiel

Appen. II Weapons and Materiel embraced the procurment of: general transportation equipment, harness and stable equipment, medical equipment and veterinary equipment, equipment for gas defense, weapons and horse drawn vehicles of all kinds, equipment for ~~pioneers~~ engineers, equipment for railroad ~~pioneers~~ engineers and fortifications (without mines and ~~[illegible]~~ fuzes), all communication equipment for the Army, optical ranging and observation equipment, motorized vehicles and tanks, all anti-aircraft weapons and anti-aircraft equipment.

About the fall of 1943 the functions included the procurement of V-2 without ammunition, but including the necessary special vehicles and ~~equipment~~ equipment for ground installations.

Added to these was the production of replacement parts of all kinds. Replacment parts were sometimes used to supply the entire weapon, furthermore, depreciation was considerable and frequently production was not adequate; in order to overcome these difficulties, an Office for Replacement Parts Procurement was created in 1942/43. Moreover, stations were established in cooperation with the industry whose task it was to find weak spots in the production picture, operating both at home and at the Front; the purpose was to make the production of replacement parts commensurate to actual requirements.

"In almost all fields of production the Office of the Reichsminister for Armament and War Production would discriminate against the production of replacement parts in favor of a high production of new equipment, the demands by the troops and by the Army Ordnance Office not withstanding. ~~Fix~~ The timely reincorporation of the (old) Ordnance service into the Army Ordnance Office (see G) would have materially helped to eliminate many a difficulty of an organizational nature in this respect, especially so far as the time requirement was concerned for the complete availability of new equipment for use by the troops and its delivery to the troops."

"The delivery orders were given to the industry in accordance with practicability for completed weapons and finished equipment, or for groups and parts, the distribution of which for use in the complete item or as spare parts was frequently regulated by Weapons and Equipment through lead-firms (Leitfirmen engineers).

The ever increasing danger from the air, transportation difficulties, scarcity of skilled workers and of raw materials, new urgent requirements by the Front, made for ever changing conditions the organization, solution of which could not always be accomplished without friction with the representatives of private interests attached to the Office of the Reichsminister for Armament and War Production. Added to these difficulties were the problems arising from the exchange of machinery between individual firms for the purpose of decreasing the requirments for new operating machinery; the exchange of experiences gained by individual firms in the field of production constituted a problem, as did the relocation of industry and subterranean plants from regions in danger from the air; the foremost requirement was always for the availability of items ~~produced~~ at the proper time for the Front, which made for the availability of such things as guns ready for commitment.

It cannot well be denied that the Reichsminister for Armanent and War Production was interested solely in that field of production on which the attention of the Supreme Commander of the Armed Forces happened to be focused at any given time, be that tanks, anti-tank equipment, artillery, et cetera. For these he would make available the necessary manpower and allot the required raw materials. The bulk of the other requirements without which the Front cannot exist, he would leave to the resourcefulness of the Army Ordnance Office, the authority of which he, himself, had curtailed."

c) Ordnance - Industrial Armament - Ammunition

Appen. II.

The small caliber ammunition, including rifle shells, were delivered by the industry in a ready state (laboriert), while large caliber ammunition (3.7 cm. and over) was delivered in individual parts, that is to say, "unlaboriert", delivery of the latter being made to the Ordnance Service of the General Army Office or to the Air Force and the Navy; the latter two procuring only certain types of special ammunition themselves.

Thus, Ammuntion embraced the procurement of complete rounds for only small caliber ammunition and rifle shells, for large caliber ammunition only the individual parts such as:

Projectile cases,
Powder rockets and bombs,
Fuzes, cartridge cases, primer caps,
Powder and explosives,
And further, smoke equipment and chemical warfare equipment.

In the field of separate parts for small caliber ammunition Ammunition provided also powder, primers, explosives and packaging material.

The assemblying (Laborierung) of ammunition delivered in parts was effected by the Army through the Ordnance Services pursuant to regulations by the Army Ordnance Office, by the Air Force and the Navy through their service centers assigned to that task.

Beginning in the fall of 1943, individual parts for cases of V-2 ammunition were supplied.

An additional burden resulted from the procurement of ammunition for captured weapons which was avoided whenever possible.

In the production of cartridge cases it was assumed that approximately 50% would flow back to the industry. These were then overhauled and readied for re-use. Due to the special circumstances in the East, a higher percentage had to be produced with attendent detrimental effect, owing to lack of the necessary preparations in the matter of manufacturing.

V) Acceptance

"Upon production of weapons, equipment and ammunition they were accepted in the factories by organs of the Division Acceptance of the Army Ordnance Office. The acceptance requirements were determined on the basis of sketches and technical specifications by the Divisions Acceptance, Development and Proving, and Chief Engineer. The Acceptance concerned itself merely with ascertaining whether any given item would serve its military purpose. That is to say, it did not constitute final acceptance in the legal sense of the word. This would be given only after receipt of the products by the Ordnance Service centers or after payment for the products by the agencies placing the orders. But even after this acceptance the producing firms were held responsible for defects subsequently developing during use of the products by the troops; this applied especially to obvious defects in ammunition (unsafe fuzes, projectiles suspected of developing cracks, defective composition of bursting charges, loose detonator charges, et cetera) if, as a result of these, damage to the troops had actually occurred or had to be anticipated (for instance, barrel bursts).

Whether an official, intermediate examination of material quality, that is to say, a tentative acceptance, of individual pieces, especially when it was a matter of parts having been delivered by branch plants, was necessary depended on the nature of the item and its functional purpose within the scope of the weapon as a whole. Thus, individual parts of guns, tanks, et cetera, as for instance, barrels, breach blocks, carriages, sighting mechanisms, were first examined in a preliminary acceptance after which the assembled weapon would merely undergo a functional test or a firing test which then would represent final acceptance. The examination was made on items of a series or by melting tests for individual items or for samples; the terms "sample" or "melting test" denoting that tests were made with individual items produced as part of a series by the same personnel from the same raw material within a given unit of time (for instance, a day), or that samples were taken from one founding out of one furnace or one crucible (as for instance, for projectile cases).

The outward examination was carried on by means of specially constructed test equipment and test regulations, sometimes also with devices customarily in use by the industry and substitute devices, while the examination of the quality of the material was made by means of physical or chemical tests. The production of test regulations, testing equipment and test machines was likewise supervised by the services of Acceptance for which purpose a special Acceptance Inspector had been appointed for the field of Test Instructions and Testing Equipment, who at the same time was in charge of this Army-owned equipment.

Finally, there was the practical functional test or the firing test for weapons and equipment to check on operational safety and quality of the parts assembled (for guns), of fire accuracy (rifles), of barrel safety (cartridge cases and fuzes), of resistence coefficient (armor plate), of uniformity (powders), of durability (motors), of operational and steering safety (tanks), et cetera. For the supervision and the execution of the firing tests also, a special Acceptance Inspector had been established. But since the practical test could not be made by firing each individual piece the officer of the Army Ordnance Office for Capacity Increase (B.f.L.) had in the course of the war proposed various simple, mechanical tests instead of the firing tests; these proposals had been adopted by the Army Ordnance Office (for instance, test of barrel safety, of fuzes by special rotation striking machines).

Whenever the tests disclosed defects, the product would be returned to the producing firm for the purpose of having the defect corrected, or it would be sold at a lesser price for purposes other than those of the Front (training fire), or it would be rejected and scrapped. Generally speaking, the firms willingly enough abided by the decisions of the Army Ordnance Office relative to serviceability of the products and the elimination of defects. Only in rare instances would the matters be taken into court, but this practice was favored especially when there was suspicion of premeditated treason or of selfish substitution of defective parts.

The requirements relative to material, outward quality, smooth working of individual parts were reduced as early as ~~b~~ the beginning of the war in many instances where a stiffening of the requirements according to peace-time standards unnecessarily retarded war production; as a matter of fact, these requirements had to be lowered toward the end of the war when the original material requirements could not be met due to the lack of adequate raw materials or when an examination as thorough as in peace-time could no longer be made with the manpower and the means available due to a steady increase in mass production. To bring about this sort of simplification with the view of production increase, the above mentioned Office~~s~~ for Capacity Increase had been established (the Chief of Acceptance was himself the head of the Office - B.f.L.) However, these shortcuts were not allowed to detract from the quality of the weapons beyond a permissible degree, to endanger our own troops, or to essentially decrease effectiveness. The efforts and the wishes on the part of the industry for reduced acceptance requirements for the purpose of increased production frequently went sky high because of the fact that the men in the industry were not always sufficiently conscious of the tasks which the weapons had to be expected to perform.

Such wishes could and had to be rejected, often with the assistance of prudent leaders in the field of economy, of time-tested firms such as Krupp, Rhein-Metall-Borsig, ~~Ek~~ Polte, Wasag which on the strengh of decades of experience were endeavoring to produce exemplary goods.

To assist the Division Acceptance the civil "Chemico-Technical Reich Institute" had been established in Berlin to function as the Supreme Institute for Physical and Chemical Tests; it was an outgrowth of the former "Military Test Institute" and disposed of excellent experiences, laboratories, testing machines and well trained personnel. For the purpose of further accelerating matters of Acceptance and to remove some of the burden resting on the above mentioned institutes, other State institutes were created in the course of the war, especially the "Test Institute for Materials" in Berlin (Material-Prüfungsamt), the "technical high schools" (academies) (Technische Hochschulen), as well as private institutes and laboratories of especially qualified concerns; after being placed under bond and after the managers were made personally responsible, these establishments were employed to assist the above mentioned institutes.

In times of peace the test firing for guns, ammunition, armor plate had taken place on the State owned proving grounds and training centers, as well as on the large, private ranges near Meppen and Unterluess, where special Acceptance centers had been established to function after these firing tests. It was shown as early as the First World War that these places could not satisfy the ever increasing demand for examination and tests; even in those times some firms had been given the permission to execute the firing tests on their own auxiliary ranges. And in a similar manner the firms involved and the Reichsminister for Armament and War Production apprached the Army Ordnance Office with the view of having these firing tests transferred to the firms themselves for the purpose of effecting economy in the matter of transportation and of enabling the firms concerned to take an active part in these firing tests and to correct on the spot such defects as might occur. Thus, these tests were made by numerous firms on their own auxiliary ranges (subterranean ranges)-firing tests against specially constructed dams, et cetera, under supervision of the Acceptance Field Offices, frequently with some security measures, which in time of peace would have been considered absolutely indispensable, carefully relaxed, and without security areas having been established.

Toward the end of the war the weapons, the ammunition, the tanks and other equipment were in the majority of cases not sent to the Ordnance Centers ("Zeugamt") any more, as had been the case ~~[illegible]~~ before, for the purpose of having them once more overhauled, assembled or otherwise put together~~[illegible]~~ (laboriert) and arranged in "formations". Parts of ammunition, for instance, were immediately assembled into ready rounds by several of the large firms under the supervision of the Acceptance Field Offices, after which they were arranged in ammunition transports to be dispatched directly to the troops, with an enormous saving of time and of transportation facilities. The same was true during the last phases of the war for assembled guns, tanks, et cetera.

For the purpose of carrying out these Acceptance tasks, the Ordnance Office had at the beginning of the war eleven Acceptance Inspection Offices (Konigsberg, Breslau, Berlin, Dresden, Hannover, Erfurt, Nurnberg, Muenster, Stuttgart, Wien and Spandau - for instruction courses); after certain Occupied Territories had been added, this number grew to sixteen (Radom, Prague, Paris, Brussel and the Inspector for Firing Tests); of this number, fourteen remained after several districts had been combined; in addition to these, there were several independent Acceptance centers at far away points (Italy, Norway, the Balkans, Ukraine), all of which at times comprised a personnel of almost 25,000. Toward the end of the war, this personnel was reduced by over one-third for the purpose of making additional manpower available for service at the Front, and a portion of the functions was transferred to the Inspection personnel of the industrial concerns who, for the purpose of facilitating matters of Acceptance, were to act on their own authority but under constant supervision by the Acceptance centers. Finally, women who had been specially trained were employed for the purpose of relieving the men capable of rendering military service.

The scope of the various districts assigned to the Inspection Offices varied greatly, often embracing several Armament Inspection districts. The districts with the largest number of employees were those of the Ruhr-area and of the regions in Saxony, Upper Silesia, Wuerttemberg and around Berlin."

VI) Division of Research

Appen. I-III

The Division of Research was charged with establishing contact with the rest of the Research centers in the country; further it was charged with Research into matters of Basic Principles and Purposes to be Accomplished insofar as these purposes were not served by other existing institutes.

The Division had at its disposal an extensive Research laboratory in Gottorp, operated in conjunction with theproving ground at Kummersdorf.

For example, it produced the scientific material for the hollow charge which developed into an important means of combat against armor, owing to the scarcity of critical materials in Germany.

It established in its office an Atomic Energy Commission to which belonged the most eminent men of the country in this field of research. This Commission functioned until about 1942/43 at which time it was incorporated into the Reich Research Council (Reichsforschungsrat). In the opinion of the Commission it was not to be expected with the then available means of research that an atomic bomb would be ready for commitment in the course of the war.

VII) The Staff of the Army Ordnance Office

Appen. I-III

The Ordnance Staff was charged with organization, planning, preparations for mobilization, distribution of raw materials within the Army in direct and personal cooperation with the Technical Staff Officer in the Office of the Armament Chief until 1942/43 and in cooperation with the Division of Defense; its further duties comprised the maintenance of relations with Foreign Military Attaches through our Attache group and so far as necessary with German Military Attaches in foreign countries; it had to bring salient material to the attention of the Chief of Armament, of the Supreme Command of Army and of the Armed Forces, as well as of the Reichsminister for ~~War~~ Armament and War Production and gather statistics.

The staff examined the periodical reports by the subordinated offices.

It was in charge of personnel matters, of members of the Armed Forces assigned to the office in so far as they could not be independently dealt with by the subordinated offices.

The management of current business lay in the hands of the Chief of Staff, while only the most important matters concerning incoming or outgoing communications were brought to the attention of the Chief of the office itself.

The perforated card records (Hollerith-System) was transferred about the end of 1940-41 to the Economy and Armament Office.

D.) Coordination of Activities

The vastness of the material to be handled, the necessity for specialization in order to accomplish the highest values, the cooperation between many offices for the creation of new weapons, new equipment, new ammunition, the ever increasing scarcity of valuable raw materials, the continuous necessity of adapting for use other materials, which were frequently of lesser quality, in all fields of production and as a result of these the continuous changes in technical specifications and Acceptance regulations, all these made for increased importance of harmonious cooperation between the various offices and of the Ordnance Office itself with outside agencies. As the war steadily assumed ~~a~~ larger proportions, beginning in the spring of 1940, efforts were made to bring about such harmonious cooperation on the basis of the following principles: first, cooperation between the individual staff offices as those charged with the actual performance of responsible tasks, then, if this method failed to accomplish the purpose, by bringing into play the higher officials, (divisions, sections and lastly of the office proper). This liaison par le bas was expected to exist not only among the offices of any given division, but also among offices belonging to various divisions within the Ordnance Office. Cooperation with other offices of the Army, of the Armed Forces (Air Force, Navy) and of the other Reich~~s~~ departments (Railroad, Post Office) and especially with the offices of the Reichsminister for Armament and War Production was predicated upon the same principle. This manner of arrangement possibly prevented the higher officials sometimes from having full insight into the routine of business; the necessary control had to be safeguarded therefore in another manner; it was on the whole effected by means of periodical reports.

Every month ~~of~~ the total production of weapons, equipment and ammunition was statistically ascertained at the very place of the respective production by the organs of Acceptance; the total production was compared to the requirements and the result of these activities were submitted to the superordinated offices and other interested services. Furthermore, there were the reports covering the activities of Industrial Armament, Chief Engineer, Division of Central Functions, each covering a period of eight days, which period was extended to ten days in 1944, the reports being finally made semi monthly. This period of time was considered adequate to enable the higher offices to intercede in time, should difficulties develop unless, indeed, these difficulties had not been brought to their attention earlier through other channels. The reports for Proving were originally made to cover a longer period of time but here, too, the reports were made beginning 1944 for fourteen days and for Proving I, sometimes for as short a period as eight days; identified as "Confidential Military Documents" they were distributed within the Ordnance Office, as well as to individual military and civilian services, outside of the Ordnance Office. They served the purpose of mutual information. In this manner, all offices concerned were placed in the position to partake of this information service and the Chief Engineer, Procurement and Acceptance Offices were enabled to plan ahead, which in turn made for more effective dispositions.

The cooperation with the Reichsminister for Ballistice and Ammunition was as a rule effected in that the Chief of the Ordnance Office would deal only with the Minister while the Division and Section Chiefs and individual Staff Officers would deal with the Technical Staff Officers within the Ministerium. The Commissions (development), the Committees (Procurement) and the Rings (raw materials and Halbzeuge) of the Reichsminister for Armament and War Production represented, if properly used, a practical solution so far as the Army Ordnance Office was concerned. A man from the industry usually served as head of the Commissions or as Chairman of the various Committees and Subcommittees. On these the Ordnance Office was represented, depending on nature and importance, by officers, officials and minor employees. And whenever practical, representatives of the General Army Office (Weapon Inspection) were brought in. The Chief of the Ordnance Office remained outside of these Commissions, et cetera, confining himself to safeguarding ~~a~~ military interests in his dealings with the "Minister".

Only on special occasions would he participate in the sessions of the Commissions, et cetera, or would he establish contact with the presiding officers outside of these sessions for the purpose of safeguarding military interests. The influence of the Ordnance Office depended, of course, on the personality of its ~~Chief~~ men who were assigned to these Commissions, et cetera. Due to the entirely different procedure and in the light of efforts to emphasize purely economic or production-technical matters, the representatives of the Ordnance Office were not always in a position to adequately safeguard military interests (of a technical, as well as tactical nature).

The representatives of the "Minister" were in a class all by themselves. As a rule, they would press a point with regard only for matters of production without any consideration for the disadvantages which were bound to result, which disadvantages in other respects would adversely affect the troops; but these representatives had in mind only the wishes of the industry and questions of production.

"The Ordnance Office also in earlier times had special "agents", although for a quite different purpose, namely, that of increasing weapon efficiency and Ordnance production without detriment to other factors. The agents of the Ordnance Office did not operate in a dictatorial fashion, rather, in full accord with the various divisions of the office and with the Reichsminister, they were always experts in their special fields who over the years had established their merits. Thus, the Chief of Acceptance who himself had come from the Division of Proving and who now was in the best position, owing to his rich experience in matters of Proving and Acceptance, to know where the trouble was, had been appointed as early as January 1942 as "Officer in Charge of Capacity Increase" (B.f.L.).

At this time the Ordnance Office increased the numberof its agents and following the appointment of an agent by the Minister would appoint a similar agent as a counterpart, who, being well acquainted with the material as a whole, was expected to prevent that all-too inconsiderate directives on the part of the Minister's agent, resulted in considerable damage~~s~~. In this manner, the Chief of Ordnance Industrial Armament, Weapons and Equipment, who formerly had been Chief of Proving for Development of Tanks, was made Officer in Charge of Motorization and Tanks; since the scope of his authority included the procurement of motor vehicles of all kinds and of all other pertinent equipment, an~~d~~ organizational unit had been brought into being. A similar situation prevailed with respect to ammunition. The agents of the Ordnance Office were authorized for the purpose of effectively coordinating their functions to issue orders to other divisions. Furthermore, in the cooperation of several offices within the Ordnance Office, one person was always designated as the one who was in charge for timely and factual cooperation with all other offices.

"In the course of the war the functions of the Ordnance Office increased considerably in spite of, and frequently because of, the fact that the Reichsminister for Armament and War Production had been brought into the picture; on the other hand, a reduction of personnel was requested. This requirement the Ordnance Office endeavored to meet by further decentralization and by shifting part of the authority downward. Thus, the heartofore existing cumbersome and tedious channels, especially in the field of Acceptance, were changed so that the decision regarding weapons, etc., which failed to come up to specifications, would not in every case be made by and secured from the central offices (Acceptance, Proving, Chief Engineer); instead, provision was made that a goodly portion of these decisions could be made by the Acceptance centers directly with strictest regard for special regulations and special instructions issued by the Ordnance Office, which regulations and instructions were not available to the firms of the industry. Moreover, a considerable reduction, by more than one-third, of the personnel, could be effected for Acceptance by combining several Inspection districts (for instance, Brussels with Minden, Dresden with Breslau and Erfurt) but above all, by the arrangement that the numerous Inspection officials of private industry who had been hired by the firms for the purpose~~s~~ of conducting their own inspections and whom these firms were reluctant to discharge, were made independent of the factory management, to be employed upon their own responsibility and under "severe penalty" in the field of Acceptance."

In spite of all efforts to streamline and accelerate the routine of business a subject matter involving a larger number of different offices for thorough consideration would take about a month; if the matter would require check with the troops or even thorough tests on proving or acceptance ranges, or examinations in the firms concerned, the time consumed would, of course, be still longer. It is needless to say that in any particular instance, if it was sufficiently urgent, all parties concerned could be brought together in a conference; with the immediate mimeographing and dissemination of the underlying material and of the decisions to be reached a certain acceleration could be brought about. The only disadvantage was that many of the parties concerned would be absent and could not be reached for these conferences upon these short notices.

The most important factor for expedient business routine under the rapidly changing conditions of war was a well functioning telephone service which permitted the directives to outside agencies and the reports by offices in the field relative to special occurrences, stoppages, et cetera, to be made to the Ordnance Office in a minimum of time without the necessity of awaiting a written confirmation before work could be begun on any given subject matter. In the first half of the war this arrangement worked well because of the numerous telephone lines converging from all parts of the country in Berlin; there was no friction or delay whatsoever. As destructions increased as a result of air raids, and, consequently, great portions of the Ordnance Office had to be moved out of Berlin, the telephone services, as well as the mail service proper, encountered ever increasing difficulties; at the same time, the directives necessary to eliminate friction and production difficulties resulting from the air raid destructions, were far more urgent than they had been at the beginning of the war. Furthermore, Acceptance had established as early as 1942 a continuous daily telephone report service from the Acceptance field offices to the Acceptance Inspectors and, in summary fashion, from these to the Ordnance Office; and at the end of 1943 there was a continuous weekly courier service for the benefit primarily of the hard pressed field offices in the Western parts of the country, which service was extended in 1944 by the creation of special postal centers to include the Ordnance Office in its entirety.£

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E.) Offices

From 1938 until the middle of 1943 the Ordnance Office, including its Divisions and Sections was located in Berlin. The General Offices and those of the Chiefs (not including Industrial Armament-Ammunition) were located in the block on Jeben Street (railroad station Zoo) and in the adjoining buildings. Industrial Armament-Ammunition, Acceptance and several sections of the other divisions were distributed in the Western Center of Berlin. This centralization in Berlin facilitated the operation down to the "Referents". But owing to the damaging effect of air raids, portions of the Ordnance Office beginning September 1943 had to be moved away from Berlin to an ever-increasing degree, a fact which slowed up cooperation and the general tempo of business routine, various counter-measures notwithstanding. The following relocations were made:

Industrial Armament-Ammunition: Wittenberg
Industrial Armament-Weapons and Equipment } General Offices Wuensdorf.
Division of Central Functions } Office of Chief: Berlin
Chief Engineer: General Offices Wuensdorf, Office of Chief: Berlin
Office of Proving: Offices of Chiefs Weapons and Equipment, Ballistics and Ammunition: Berlin, other parts Kummersdorf, Hegesee, Hillersleben.
Acceptance: Wuensdorf.

For Acceptance the transfer to Wuensdorf was especially disadvantageous because business had to be conducted with the many hundreds of Field Offices scattered all over the country, principally by telephone, for which purpose the telephone facilites in Wuensdorf were to the very end entirely inadequate which made for serious delays in matters of production, acceptance and shipment.

Moreover, the barracks block in which Acceptance had its Wuensdorf offices was badly hit during the course of an air raid in the spring of 1944, it was totally destroyed by a second air raid in the beginning of 1945; after extensive cut-down in office space an additional transfer to Halberstadt was found necessary, until these quarters too fell victim to an air raid. The other parts of the Army Ordnance Office which had been transferred to Wuensdorf were also so badly damaged in the course of the aforementioned air raid that they had to be transferred together with some other parts which until then had remained in Berlin, to the region of the Harz Mountains.

F.) Personnel

The characteristics of the Ordnance Office resulted in the office being staffed with personnel of various kinds. The demands made on the office were of a military nature, the compliance with them was a technical matter with constant regard for military ~~xxxxx~~, technical and economic aspects. For this reason the personnel of the office was composed of soldiers, trained technicians and ~~individual~~ economists.

Among the military differentiation had to be made between: troop officers with technical academic education (Dipl.Ing.) and officers without this education. The latter had in the majority of cases developed into specialists in their particular field, which made them especially valuable by virtue of their long years of ~~pxx~~ practical experience. The officers (W) possessing some amount of technical training and usually coming to the office from the Ordnance Service within the Army General Office, were generally employed in the field of Proving as specialists or in the field of Acceptance predominantly. The academically trained officers (Dip.Ing.) would alternate between the Front and the Ordnance Office; by this arrangement they would bring back to the Ordnance Office the experiences gained while serving with the troops, thus constituting effective intermediaries between the demands of Weapon Inspection and their practical fulfillment in the technical field. They constituted the majority of "Referents" with Proving, in exceptional cases with Industrial Armament-Weapons and Equipment and with Ammunition. Also recruited from their ranks were the Section Chiefs with Proving and gradually also with the remaining Divisions, as well as the Digision Chiefs themselves. Officers (Dipl.Ing.) who had no prospect of advancement in either the Ordnance Office or at the Front were supposed to be employed as specialists in their given fields. The positions of the Commanding Officers for the Proving grounds also were considered proper places to which to promote these Officers (Dipl.Ing.); these positions were likewise made available for those specialists who had distinguished themselves by especially meritorious service.

The technical training of the Officers (Dipl.Ing.) embraced the following subjects: Machine Construction, Physics, Technical Chemistry, Technical National Economy, Construction Engineering, Electro Technique. The opportunity for practical activities in their respective branches of the industry as it was offered in an adequate degree to these officers, immediately before and during their academic studies, was fully utilized only in a few cases. For this reason the men usually lacked adequate practical experience as it might have been gained in the factories and other places for practical technical activities.

Engineer Officers were not employed by the Army Ordnance Office 1/

1/ A distinction must be made between the troop officers (Dipl.Ing.) and the so-called Engineer Officers who headed the technical replacement and repair service for motorized and kindred troops. They had their weapon representatives in the Engineering Inspection of the General Army Office. No provision was made for the employment of these men in the Army Ordnance Office, although such employment might have been advantageous for both the Ordnance Office and the troops if provisions had been made for commensurate employment and exchange of suitable officers.

While the troop officers (Dipl.Ing.) alternated between Army Ordnance Office and Front, the other senior (completed academic education) and intermediate technicians rendered uninterrupted service to the Ordnance Office. They had gone through more or less extended practical working periods in factories and other places of practical technical activities and constituted the unchanging nucleus as against the continuous change of troop officers (dipl. ing.) and of many officers who were employed as specialists.

The technicians were either civilian officers (Beamte) or employees. Inasmuch as no employment of a military nature was provided for these senior officials, this limitation constituted a certain difficulty whenever there was a decrease in efficiency. This fact offered no difficulty in the case of the employees who could be given notice at any time that their employment was terminated. In the light of the aforementioned limitations and of the salary provisions, it was difficult to obtain good men as employees and to keep them. The senior and intermediate technical officials were frequently recruited from the same category of employees. For the senior technical officials a number of positions of "Ministerialrat", "Ministerialdirigent" (usually section chiefs), for the Chief Engineer that of a "Ministerialdirektor" were provided. Advancement however was not predicated solely on seniority. The most capable men were advanced out of turn which constituted that much more inducement. Opinions as to who should have the leading position within the office differed; should it be an officer or should it be a technician. In the opinion of the Ordnance Office itself both were to be afforded equal authority even though the wishes and the needs of the troops would constitute the ultimately decisive factor. The arrangement, as it was tried out in another part of the Armed

Forces, assigning the principal responsibility to the officers at one time and to the technicians at another, an arrangement which had not produced the desired results, and made it necessary to move with extreme caution in the treatment of this very important question.

The Army Ordnance Office took this way out: The leading positions which demanded absolutely experience with and confidence of the troops were filled by officers. Whenever particular insight into and understanding for technical matters and cooperation with technique were required, officials (Dipl.Ing.) were employed; in order to vest the senior technical officials with the outward appearance of a corresponding degree of influence the position of "Advisory Engineer" was destablished for the divisions and their sections about the beginning of 1943. For this position it was the custom to select the most "suitable" man from the realm in question, who would add this particular assignment to his other duties. Of course, considered were only those engineers who, aside from being factually suitable, had the type of personality requirdd for safeguarding the interests of technique. They were authorized in cases where no agreement could be reached to submit their personal opinion in any given matter to the Advisory Engineer of the next higher office and it was their duty to submit their own expert opinion together with that of the engineers' within the scope of their activities. In order to keep the best qualified technicians abreast of the practical achievements in the field of technique, the plan was to assign them for two years to some fadtory or some other place of practical, technical activities. Due to the urgent conditions as a result of the war, this plan never materialized.

The technicians without academic education were recruited not only from the ranks of the employees but also from suitable, intermediate, technical officials of the troops. Moreover, Acceptance would obtain a number of its employees from the ranks of the Technical Sergeants.

In addition to this technical personnel, the Ordnance Office employed a number of other employees for office, typing and miscellaneous service.

The personnel of the Ordnance Office from 1939 until 1941 numbered about six to seven thousand. From 1941 until 1944 about five to six thousand (compulsory personnel reduction).

The nucleus personnel of the Proving grounds amounted to about two thousand.

Owing to the characteristics of the Army Ordnance Office there was always the danger of larceny and embezzelment, et cetera. But since decisions were usually not made by just one office but rather by several in cooperation with one another, this in itself tended to make personal dishonesty difficult. To illustrate, entirely separate from, for instance, Procurement (Industrial Armament) were: Examination of bids (Supreme Command Armed Forces), Technical Selection (Chief Engineer), Acceptance. Consequently, infractions of this kind were extremely rare. The few attempts at bribery in Acceptance were insignificant. In any event, all instances of dishonesty were prosecuted without delay.

The opinions differed widely on the question as to the education to be required for the Chief of the Army Ordnance Office. Since he had to possess sufficient tactical and strategical experience, it was considered necessary for him to have at least the position of a Commanding General. Furthermore, it is necessary that he have understanding and love for all technical and economic matters. In the case of specialists, pure and simple, there is too much danger of one-sidedness.

G.) Changeover to Ordnance Office of Armed Forces

Appen. V. The Army Ordnance Office as early as 1927 had suggested and in 1936 had requested the creation of an Ordnance Office for the Armed Forces. The need for such an office was predicated upon the necessity to standardize Weapons, Ammunition and Equipment in order to have the least possible number of different types of these coming into mass production and also to obtain a maximum uniformity in dealings with the industry and the other services expected to meet the requirements. The scarcity of raw materials prevailing in Germany pointed in the same direction. The request met with no success. The Economy and Armament Office (Wehrwirtschafts-und Ruestungsamt) which was supposed to bring about some of these improvements, did not prove efficient.

The above mentioned necessities were emphasized by the war in an ever increasing degree. The creation of the Officeof the Reichsminister for Ballistics and Ammunition and its extension to Armament and War Production did not fully meet these requirements. While the Army endeavored to recognize the authority of the Reichsminister without relaxing the safeguard of its military prerogatives, the politically stronger parts of the Armed Forces - Navy and Air Force - came around to accept the authority of the Reichsminister for Armament and War Production only in May 1943 (change of Command: Raeder - Doenitz) and about January 1944 (Jaegerprogramm). The well-nigh unavoidable further development in the organization of the Army Ordnance Office, characterized by an adaption to the organization of Commissions and Committees of the "Minister," emphasized the need for reorganization. It was possible that the solution lay in the direction of splitting up into special groups such as Weapons, Ammunition, et cetera. An objectional feature was that Construction (Proving) and Mass Production (Industrial Armament, Weapons and Equipment and Ammunition) were supposed not to enter into too close relations with one another, lest new weapons would be given to mass production at too early a date, before they had been adequately developed for mass production, that is to say, before matters of construction had been completed, and before the construction had had been sufficiently simplified and the troop tests had taken place.

A typical example for mass production having been prematurely undertaken is presented by the production of tank V Panther. Development and Proving, Section Motorization and Tanks, recognized as early as November/December 1942 that to undertake mass production (Assembly line) by April 1, 1943 would be too early and consequently suggested, with the Army Ordnance Office concurring in this suggestion, that the date be set for July 1, 1943. In spite of this suggestion, the Supreme Commander of the Armed Forces personally insisted upon April 1, 1943. The result was a fairly large number of "childhood diseases" for the mass production and instances of failure at the Front, especially of the motors.

Even with the organization as it existed efforts were made on the part of Proving to add improvements to series-production in course, which efforts slowed up output. For this reason the Ordnance Office issued orders that improvements in the production of any given weapon could be made only in such a manner that the output of current series-productions was not disturbed. Whenever an improvement for any given weapon was of decisive importance ~~which~~ makes it necessary to disrupt the output of a current series-production, the approval of the Chief of the Office had to be obtained.

If, by means of new organization, the separation of Ordnance Service from the Ordnance Office could once more be eliminated, the result could only be called advantageous, because it had always been considered a definite disadvantage that the Army Ordnance Office did not have sufficient insight into and influence on the composition (laborierung) of ammunition, storing and requirements, as well as consumption of equipment and replacement parts, –

further, on overhauling of equipment and on matters of personnel within the T~~act~~echnical Staff and of the W-Officers. This would not have prevented the matter of distribution remaining, as always, a function of the office directly concerned.

The new Chief of Armament (separate from Commander of Replacement Training Army after December 15, 1944) ordered the change-over from Army Ordnance Office to Ordnance Office - Armed Forces to begin on January 15, 1944. The Army Ordnance Office went on record as being opposed to the change-over at this particular time, believing that such an extensive change in organization was bound to be detrimental in the light of the over-all military situation; it believed that the old organization should be allowed to continue until the end of the war. Furthermore, the Army Ordnance Office was of the opinion that an organization growing out of what then existed, would be more practical in time of war. In peace-time however, the reogganization, according to appendix V, executed without undue haste, would have been preferable.

The new organization for the Army Ordnance Office (that is to say, for the Armed Forces Ordnance Office, which was about to come into being) is presented in appendix V. Incorporated into the then existing five Divisions, which were independent in their individual functions, were sections for development and proving, procurement (Industrial Armament), acceptance and ordnance service (Feldzeugwesen), all having their particular scope. Maintenance of uniformity and supervision of these sections created within the Divisions was to be effected through the Chiefs of diagonally-arranged services (Querverbindungen).

"The organization of the Armed Forces Ordnance Office in 1945 came too late to be effective and too late as that the necessary experiences could have been gained. It can however be said that such an organization would have been practical even in peace-time. To delay so drastic a change in organization until mobilization or to bring it about under the tensions of war, could be expected to do considerable damage."

The plan was to add on April 15, 19450 additional groups: Aircraft Construction and Ship Building. There was no time left to realize these plans because on that day the Army Ordnance Office had already been split into a weaker group in the North and a stronger one in the South. Pursuant to orders, the Chief of the Army Ordnance Office transferred his offices to Southern Bavaria. On April 27, 1945 the Army (Armed Forces) - Ordnance Office - Groups-South was dissolved upon order of the Chief of Armed Forces (Army) Armament.

H.) Accomplishments

I) Introduction

It would transcend the scope of this work to fully enumerate the infinite accomplishments in the fields of Development, Proving and Mass Production of weapons and ammunition of all calibers and all kinds, of all equipment in its infinite variety, and the stoppages and difficulties occurring during the performance of these tasks; at best, they could be mentioned in passing. Written material, including monthly production data, are not available. The cooperation on the part of persons familiar with the subject matter can be secured only to some extent; for these reasons the presentation here must confine itself to a few characteristic, noteworthy items, and the circumstances surrounding the variety of activities involved may at best be highlighted in catchwords.

For thorough and exhaustive treatment of development of weapons, ammunition and equipment during the period covered by this report and before, Lt. General and Dipl.Ing. Erich Schneider, living at the time at Schloss Leitheim near (13 b) Donauwoerth, would be eminently qualified, who for many years was a member of Ordnance Proving, occuping positions of various kinds within this division and at the Front, last in 1943 - 44 as Chief of Ordnance Proving.

II) Technical and General Preparations for Mass Production

"The administration of construction data (equipment, instructions, tools and machinery, the necessary drawings, sketches, blueprints for these, the specifications) for all manner of Army materiel (weapons, ammunition and equipment) was centralized in the Army Ordnance Office. The changes in the original drawings, et cetera, (Originale) were likewise centrally made by the Army Technical Bureau (H.T.B.) of the Chief Engineer, or were supervised by agents assigned to individual concerns.

The Armament Inspection Offices had branch offices charged with the administration of this printed material, their duty being to provide the tracings, to the firms within their districts.

The demand for these tracings by industrial concerns and by the service centers of the Army was enormous and amounted to millions of copies every month.

The changes in the drawings, et cetera, necessitated by the rapid progress in matters of development during the war were exceedingly numerous.

Thanks to the effective organizatinn of the centralized activies of the Ordnance Office, ~~the~~ instances of construction errors as a result of incorrect drawings, et cetera, were rare.

In reliance upon its experiences during the war of 1914-18, the Army Ordnance Office has at all times emphasized the importance of providing the industry with proper construction data, these to be prepared independent of existing differences between production methods of the various industrial firms concerned. This drawing-system of the Army was, after initial strong reluctance, acknowledged as good and adopted by other parts of the Armed Forces and by the industry.

Production technical preparations as they were required for mass production, were made by the Army Ordnance Office to the greatest possible degree. Aside from standard-technical examination of the drawings, the production technical examination, as effected through the Special Engineers in the Army Technical Bureau, embraced production technical simplification of individual construction parts, the most economic use of materials, especially of critical materials, and the application of all permissible tolerances for the purpose of facilitating machine production. These tasks were performed in close cooperation with the developing concerns which received these technical requirements in the form of construction specifications as early as development had begun.

The most economical use of critical materials (non-ferrous metals and alloy metals, et cetera) was recognized by the Army Ordnance Office at a very early date as one of the most important factors. When in the course of the war, the scarcity of critical materials steadily increased, it was nevertheless possible, in cooperation with the firms in the industry, to satisfy large portions of the requirements by the use of substitute constructions and low alloy steels, et cetera.

Below are given a few typical examples of how economy was effected of non-ferrous metals and what substitutions were made:

1) Infantry cases from steel instead of brass;
2) Artillery cases from steel instead of brass,
3) Rotating bands from sinter and soft iron instead of copper,
4) Plain bearings from plastics instead of bronze, or roller bearings instead of bronze plain bearings,
5) Fuzes from plastics, steel and zinc instead of brass or aluminum,
6) Infantry projectiles from sinter iron instead of lead with steel jacket.

In the course of the war the originally provided high alloy steels for guns, armor, motor parts, et cetera, were extensively replaced by low alloy or non-alloy steels, for which purpose adequate warm treatment played an important part (for example, surface hardening of armor sheet steel).

The production simplification and the simplification of weapons, equipment and ammunition itself has always been given thorough attention during the war; at first, this met with resistence on the part of the developing firms which appeared reluctant to produce simple equipment involving a lesser amount of labor. Only gradually did the idea prevail. After that, good results were effected in cooperation with the industry.

As an example, the introduction of the technique of sheet steel stamping in the production of infantry weapons, typified by the assault rifle and the machine-guns 42 and 45, brought about essential savings in machines, installations, working time and materials. Another example of simplification in the field of ammunition production is the plastic fuze, the manufacture of which required but a fraction of the time needed for/the production of a metal fuze.

The production sections in the Office of the Chief Engineer have materially helped in the mass production of weapons, equipment and ammunition commensurate to the ever-increasing demands on time and further, in applying the latest technical advances to current production. The supply of production machinery, installations, and means of operation (tools, devices, instructions) to the firms in the industry was centrally administered by the Ordnance Officer; this function later to be transferred to the Office of the Reichsminister for Armament and War Production.

Furthermore, the manufacturing sections had charge of the new plans for works and work shops in close cooperation with the firms in the industry.

The current improvement of manufacturing methods, the development of labor saving production machinery, of tools and of devices were objects of constant endeavor.

The considerable capacity increases which were attained played their part in essentially satisfying the requirements, the over-all situation in the field of production, bad as it was as a result of the bomb war, notwithstanding. The instances where the requirements could not be met were predicated more on a scarcity of materials (too small an allotment for the Army) than on the lack of the necessary production capacities.

These are some characteristic exemples for this field:

1) The swinging of gun babrels which, in addition to a saving of raw steel of up to 75%, constituted a saving of working time of approximately 50% and relieved the forges accordingly.
2) The working time required for gun barrels was reduced by about 9/10ths by the employment of high capacity production machinery and tools.
3) The hammering of grooves for infantry weapons effected a saving of about 90% of the working time.
4) The introduction of cold-spraying for steel-cases for the artillery permitted filling the enormous requirements.
5) The substituting of sintering for phases of machine tooling.

"Mass Production depended on the allotment of raw materials, primarily of iron and steel. The need was, as a rule, not satisfied.

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Matters of allotment lay in the hands of the Chief of Armament and Commander of the Replacement Training Army, later in those of the Reichsminister for Armament and War Production.

Upon highest orders the economic preparations for mobilization were begun only in the spring of 1940. The mass production for the Army was temporarily stymied in the summer of ~~194~~ 1940 in favor of primarily the Air Force and the Navy, but it was decisively stymied (for example, reduction from 170 light field Howitzers ~~per~~ per month, down to 20) toward the beginning of the fall 1941, restrictions which were lifted only toward the beginning of the winter 1941/42, following urgent requests to that effect. The demands for reduction were carried to a point where already existing "Halbzeuge" were supposed to be melted down. It took a long time to make up for this set-back.

(Classification Stamp)

III) Presentation of Individual Weapons, Materiel and Ammunition in Development and Mass Production.

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a) Weapons

1) Machine guns

As a result of purely defensive warfare in 1916 the "Machine gun-Ideology" had taken firm roots, an ideology which in the years thereafter brought about more burden for the Infantry, decreasing its mobility and 'living' striking power. Thus the emphasis was on the development of machine guns. The numerous operating personnel for the machine gun was not being reduced, and the introduction of the considerably lighter machine gun 34 did not make for any essential changes. This machine gun (with rifle cartridge 98) had not gone through all "childhood diseases" by 1938; it had highly sensitive mechanism and at times represented the highest nickel consumer in the armed forces. The high moral effect of the great fire rapidity with machine gun 34 brought about the demand for further increase in the fire rapidity. Since such an increase was not to be achieved under the construction of the machine gun No. 34, a changeover was made to the machine gun model No. 42 which was far simpler, far safer to operate and in point of raw materials, more advantageous, aside from being more resistent to cold and heat; it had a fire rapidity of about 150 rounds per minute; shortly before the end of the war the machine gun No. 45 was offered as a new solution with the very simplest of raw materials and a far greater production capacity with less production facilities. The builder and the data for the construction of this machine gun No. 45 are today in Russia.

In the beginning, mass production of machine guns amounted to 10 to 12 thousand per month. This figure was reduced in the fall of 1941 to ~~4~~ 3 thousand (not quite executed); beginning January 1942 the production was once more raised to 12 thousand monthly and was further increased beginning 1944 to 24 thousand in the same period of time.

2) Rifles

There was a demand for an automatic rifle (bursts) but only with rifle cartridge 98 (1937). There was no way of meeting this demand in a satisfactory manner because the weapon had to become too heavy due to the heavy recoil with the large powder charge. There were merely improvements of the rifle 98-not considering the short rifle, about 1934, (shorter barrel and lesser weight) which in turn led to the development of the self-loading rifle 43 (single-shot fire).

In order to find a way out of this unfavorable development, the Army Ordnance Office in the fall of 1940 decided to develop an automatic rifle with sufficiently accurate single shot up to 400-600 m.(also cartridges with smaller powder charges - the so-called short cartridge) weighing the same as the short rifle 98, the intention being to demonstrate the completed weapon for the servides concerned. The automatic rifle with the short cartridge was capable of replacing the submachine gun (38) with the result that as before two kinds of cartridges (rifle cartridge No. 98 and machine gun cartridge) continued to be carried by even the smallest Infantry unit (rifle cartridge 98 and the short cartridge). In the course of these developments it was established as a matter of practical experience in the opinion of many Infantry men, that the so-called light machine gun could be replaced by the automatic rifle (later called the assault rifle), with the result that within the company only the short cartridge was carried.

The military offices permitted themselves to be convinced of the necessity for the introduction of the assault rifle. There was a demonstration of this weapon for the benefit of the High Command of the Armed Forces with the Chief of Armament and Commander of Replacement Training Army present; shortly before this demonstration was to take place the Chief of the Army Ordnance Office was instructed by higher orders to refrain from attending that demonstration which instructions prevented him from disproving the erroneous two-cartridge theory; the Supreme Command of the Armed Forces refused in the spring of 1934 to accept the assault rifle, basing his refusal on this duality of ammunition. The Army Ordnance Office was not officially informed of this decision with the result that manufacturing preparations were continued and the mass production which had slowly been begun was allowed to go on; only on the part of the Reichsminister for Ballistics and Ammunition did some resistence gradually make itself felt. In May/June 1943 the Chief of Armament and the Commander of Replacment Training Army suddenly issued orders orally to discontinue all manufacture of ammunition for the assault rifle after July 1. The efforts of Front line Officers brought it about in September 1943, upon presentation to the Supreme Command of the Armed Forces, that the assault rifle was adopted, after all. After it had been brought to the Front as test weapon by the Infantry Division, the men at the Front had become acquainted with the weapon and had been favorably impressed by it.

Toward the end of the war there was a new model for the ammunition of the assault rifle which could be termed the "Woolworth-Machine Gun". The construction data are today in Russia.

Up to 1943 the production of the rifles amounted to about 100,000 per month which was supposed to be increased to 300,000 per month owing to the requirements in the rearward areas. This enormous demand for rifles finally led to the development of the peoples' rifle (Volksgewehr), a very simply constructed rifle, easy to produce with rifle cartridge 98. The Army Ordnance Office proposed the adoption of a further simplified short rifle 98, requiring about 7 man hours instead of the 12 hours heretofore, this proposal was submitted in November 1944, and by the end of January 1945 the Army Ordnance Office was in a position to announce a output of about 70,000. The Military Offices were in accord. The Supreme Command of the Armed Forces decided that the selection of models and questions of production should be left to the regional administrators (Gauleiter). The Army Ordnance Office has not learned that a serviceable peoples' rifle was brought out in any sizeable number.

About 1938 a telescopic sight for the rifle was demanded. The Army Ordnance Offide suggested a four-fold magnification while the Offices concerned demanded one and one-half magnification; in accordance with that demand the sight was developed and introduced. This was an instance where an effort was made on the part of the industry, through very high offices in the party, to force upon the Army Ordnance Office a sight which, while technically very good, was unsuited for military purposes. In the course of the war, the need arose for a telescopic sight with four-fold magnification, anyway, and such a sight was introduced about 1942.

3) Submachine Gun

Submachine Gun 38 (with 9 mm pistol cartridge 08) never was entirely satisfactory, several improvements notwithstanding.

4.) Armor for Infantry

The introduction of a steel helmet which, owing to its more advantageous shape, would offer twice the protection as before, was frustrated in 1943/44 by questions of tradition; in the same manner small armor shields and camouflage shields for the faces of the riflemen had been rejected even in times of peace.

The Army Ordnance Office was unable to conceive its duties as lying merely in the field of preparation for mobile warfare. It recognized its duty to prepare for position combat and for position warfare; if this was not done, practical suggestions could not be expected to come forth quickly enough in cases of emergency. Such equipment as, for instance, trench periscopes, et cetera, could be held in readiness without being given to the troops while they were engaged in a war of movement.

5.) Defense Against Tanks and Low Flying Aircraft.

aa) Antitank Artillery.

Up to 1940 the antitank gun 3.7 cm. was the principal antitank weapon, but was not adequate against the 40-60 mm. thick walls of the Renault B2. In anticipation of this fact an antitank gun 5 cm. was developed early which it was possible to commit through a test battery in the campaign in France where the weapon entirely proved itself. The further development moved in the direction of replacing both guns by guns with conical barrel and using projectiles with tungsten cores which, as a beginning, would have possessed sufficient penetrating power for combat distances, being at the same time light enough. But since the procurement of tungsten was too uncertain, a changeover was made about the middle of 1941 to the further development of cylindrical barrels of about 7.5 cm. and conical barrels, without tungsten projectiles. Through this changeover, valuable time had been lost; but the tank T-34 which had made a sudden appearance in the beginning of the campaign in Russia, created the need for the rapid development of a substitute for antitank gun 5 cm. which even with high explosive shell 40 (subcaliber projectile with tungsten core) was for combat distances not enough against the tanks' strong inclined planes. Through test fire against T-34 at the East Front, the Army Ordnance Office by June 30, 1941 was convinced that the 5 cm. antitank gun had to be replaced quickly and in June, 1941 ordered the production of 300 barrels (preliminary construction) for 7.5 cm. antitank gun to be made into either cylindrical or conical barrel; at this time the construction had not progressed beyond the developmental stage. In the beginning of November 1941 several models were tested in Hillersleben. The conical barrel on a carriage for which the shield simultaneously served as the axle, was eliminated (only about 100 of these were produced), the 7.5 cm. antitank gun 40 was accepted in spite of its somewhat heavy weight, but powder and other ammunition had still to be developed for it. In any event, it was possible to commit quite a number of these guns in the second battle of Kertsch in April 1942 and in the first battle of Charkow in May 1942. Cartridge jammings represented a number of defects because the powder which naturally was too fresh had not - contrary to experience - become weaker but stronger. In the long run the armor piercing capacity of the 7.5 cm. antitank gun 40 at a distance of 1,000 m. amounted to about 90 mm. against armor with 60 degree inclination and a tensile strength of 120 kg/mm^2. Production rose to about 600 and in '44 to 1,000 per month as the loss of equipment became heavier.

The switch to mass production of the heavier calibers for anti-tank guns presented difficulties because the supply of machines for the 3.7 cm. antitank gun, although it had been anticipated that they would eventually come into play for the 5 cm. antitank gun, was not adequate.

From the 7.5 cm. antitank gun 40 on the lightly armored carriage of the former Czech tank 38 (t) grew, in the beginning of 1944, the tank(fighter) (Panzerjaeger) 38 (t) with 6 cm. front armor and 30 deg. inclination. The gun was supported in such a manner as to eliminate recoil; this feature put considerable strain on various parts of the gun, especially the optical equipment, causing them to break frequently.

The need for further increase of penetrating power and for the enlargement of combat distance led to the adopting of the time-proven 8.8 cm. antiaircraft gun which had likewise been developed earlier by the Army Ordnance Office and which had proved very effective in operation against tanks; it was in the beginning employed as an 8.8 cm. antitank gun on a split-trail gun carriage (temporary expedient), later on the all-around (out-rigger type gun mount)(weighing 4.5 tons, so that during large-scale operations it usually fell behind); finally it was also employed as a gun for flat trajectory fire in the light artillery on self-propelling carriages with armor against fragments. Due to the impending collapse, this gun was not produced in any considerable quantities.

While the antitank guns could have their own armor piercing shells, owing to their high initial velocity (Vo), high explosive shells with hollow charge were adopted for the guns with lesser muzzle velocity (for instance, light field Howitzer 18); these shells burned a hole, so to speak, through the armor and then sent a stream of burning gas with a temperature of about 3,000 degrees through the aperture. In the beginning the effectiveness was low, but by means of a more advantageous construction of the hollow and by substituting for the trinitrotoluol bursting charge, even stronger explosives (Hexogen and Nitropenta), the penetrating power was gradually increased to about 100 mm. for all distances. The disadvantage was that the hollow charge shells were not altogether effective against the oblique planes, and that to be effective, they should not reach the target with too high a terminal velocity, that as a result the beaten area was smaller and the fire accuracy impaired.

bb) Tank Defense for the Infantry in Combat Itself.

The desire to destroy enemy tanks before they had reached our own Infantry, led to the introduction of means for antitank operations by the Infantry itself. Hard core (tungsten) ammunition 7.9 mm. caliber for rifle and machine gun (armor piercing capacity 16 mm. with 60 deg. inclination, tensile strength 120 kg/mm^2)was no longer sufficient; the same was true for the somewhat stronger antitank rifles 39 and 41. Temporary solutions were provided by:

1. Magnetic antitank hollow charges, 2. rifle grenades with hollow charge, 3. 1942/43 "Panzerschreck" 8 cm., also called Stovepipe, an imitation of the American 5 c.m Bazooka) and the so-called 4. "Puppchen" (Little Doll) which was effective for distances up to 300 m. The "Panzerfaust", easy to operate, low weight, great effectiveness (penetration up to about 200 m.) later established itself as the principal antitank weapon for the foot soldier.

For the last three mentioned weapons, hollow charges and the rocket principle were used.

Another effective means for antitank operations were the mines. T(ank) mines made from iron with fuzes 35 were the equipment during the first phases of the war and during its major part. Production amounted to at least 100,000 per month. Non-metallic mines and fuzes as a means of protecting them against being detected with electrical mine detection equipment, were ready to be procured about the end of 1943.

Then there was DZ (pressure and pull igniter) 44, a fuze which would cause the mine to detonate in case of an attempt to remove it.

Properly employed and equipped, antitank defense could be termed as being still adequate.

cc) Defense Against Low Flying Aircraft

Defense against low flying aircraft was provided by concentrated rifle fire, sustained machine gun fire, these guns having special mounts, and at the beginning of the war, by fire from machine guns from twin mounts in specially constructed cars.

Toward the end of the war there came into being the "Fliegerfaust", this weapon was produced in the amount of about 1,000 pieces. Its operation followed the shotgun principle, the weapon having two light/metal barrels (weighing about 2 kg.) from which were fired ~~two~~2cm. shells with rocket propulsion which at an altitude of 500 m. covered an area with a diameter of about 50 m. and which after a flight of about 800 m. would explode automatically.

Equipped with assault rifle, rifle grenade, bazooka and "Fliegerfaust", the Infantry was once more given that degree of mobility and the "living", striking power which it needed for the performance of its tasks.

6.) Artillery

aa) Light and Heavy Artillery

"By September 1, 1939 the mass production was in full swing for

10 cm. gun 18 with power traction
Light field Howitzer 18 (10.5 cm.))
) Horsedrawn or power traction
Heavy field Howitzer 18 (15 cm.))

15 cm gun)
) with power traction;
21 cm mortar)

the mass production of these weapons varied according ~~in~~ to the speed with which the peace-time Armies were being equipped, amounting up to that time to ~~a~~ monthly maxima of 115 and 30 for the light field Howitzer and the heavy field Howitzer, respectively.

The campaigns in Poland and France had presented little requirements for barrels and had resulted in hardly any loss of equipment, the same was true for the beginning of the campaign in the East."

A reduction in the production beginning about fall 1941 was effected chiefly at the expense of the Artillery. But owing to the position warfare in the East, the demand for guns and replacement barrels soon rose. The battles which were to follow and which made for heavy losses resulted in such losses of weapons and equipment that further production increases became necessary, which for the light field Howitzer rose to about 700 per month (October 1944: 1,000(?), December 1944: 1,100 (?)), the figure of 700 per month being attained in 1944. Similar conditions prevailed in the production of the heavy field Howitzers, with a demand of about 300 per month, a demand which was not even approximately filled; less heavy losses were suffered for 10 cm and 17 cm. guns and mortars for which reason there was a lesser demand for these weapons.

~~Since~~ At the same time the production of anti~~tank~~ aircraft guns, for instance, 8.8 cm antiaircraft gun, had to be increased from 40/month to 300/month, the same necessity for increased production exist~~ing~~ed for tank guns and antitank gun. The situation in the production field became especially tense. Emergency measures as they are discussed under H II, made it possible to overcome many of the existing difficulties.

The experiences at the Front, especially in the war of tanks, the demands for increased firing distances for simplification in the matter of manufacture, the possibility to move greater weights by power traction, all these had various effects in the field of development; however, in the long run the progress made in the field of development could be of limited benefit only and in many instances production did not go beyond that of some test weapons.

There was full justification, generally speaking, for the demand for all-around fire, a demand which however could only be met in isolated instances.

The light field HOWitzer first underwent a reduction in weight by 200 kg in order to make that weapon suitable for movement by horses (light field Howitzer 18/40). The development of the light field Howitzer with all-around traverse, increased firing distance, (range) armor against chemical and other attacks from the air, remained in the experimental stage, the same was true of the heavy field Howitzer. In the field of the mountain gun, a piece was in development with increased firing distance and all-around traverse. An excellent gun was developed about 1940/41 in the form of the mountain Howitzer (10.5 cm), four loads with half-track motorcycle or animal tandem power on pivot-type mount.

A substitute for the light Infantry gun 18, which for a time was not being produced, ~~[illegible]~~ was found in Infantry gun 44 (?) with enlarged powder chamber, resulting in uniform gas pressure in the barrel, with arrow shell, flat and arched trajectory and a sufficiently large beaten area against tanks up to about 800 m, with a weight of about 450 kg when in position. Mass production for this weapon was begun toward the end of 1944.

The heavy Infantry gun (15 cm) which as such had proved itself, was introduced in 1938 all too hastily and had as a result manufacturing defects.

A lightweight gun (caliber 10.5 cm), (projectile that of the light field Howitzer, partial reflection of the propelling charge instead of the recoil mechanism, weight approximately 350 kg) which was developed about 1940 had proved its value for special purposes (parachute) (4 loads), bicycle formations. Only a small number of this weapon was produced (high powder consumption, much muzzle fire (flash) and smoke (dust)).

The idea of once more emphasizing light guns for the light artillery was devious, since the single round lacked moral and fragmentation effect. On the other hand, it was reasonable to give to the light artillery guns with greater fire accuracy against tanks, something which, because of the larger beaten area, was possible only through greater muzzle velocity and through increased firing distance. For this reason the 7.5 cm antitank gun 40 with various charges, and above all the 8.8 cm antitank gun on all-around carriage and self-propelling carriage with protection against fragments, were introduced for the light artillery. No production of any size was accomplished for the latter weapons (see 5).

The heavy, flat projectory fire moved in the direction of larger calibers in order to increase the effect of the individual round, as well as the firing distance. The 10 cm gun and the 15 cm gun were replaced by the 12.8 cm gun (delivered about beginning 1944) and the 17 cm gun, respectively, the latter on the carriage for the 21 cm mortar (introduced and produced beginning 1940). There was no time left to effect the substitution of the 24 cm guns for the 21 cm guns (German and Skoda construction).

Thorough tests were made for sliding, square-wedge breach block and interrupted ak screw-type breach block in the course of which the men came to believe that the latter was more suitable for the heavy calibers. Also, there was less reluctance to introduce the air brake instead of the hydraulic brake for barrel recoil, while the pneumatic recuperator had proven itself as superior to the spring type recuperator.

bb) Special Caliber

Flat Projectory Fire:

K3: 24 cm gun, power traction in 4 loads, range about 35 km

K5: 28 cm gun, range about 56 km, railway gun, power traction had been developed, couldn't be brought about because no Tiger-chassis could be made available for barrel transportation (see also b,6; dd and ff).

K12: 21 cm gun, railway gun, range approximately 120 km

Dora: 85 cm gun, railway gun on 2 parallel tracks, range 40 km, weight of projectile about 7 tons against strongest fortifications. Commitment in the field against Sebastopol and Petersburg. Did not come up to expectations. Three guns in the process of construction, two completed, the execution of the order on the part of military authorities to stop further construcgion of the third piece was frustrated through non-military influence with the Supreme Command of the Armed Forces.

High Angle Fire:

35 cm: Power traction, about 7 pieces produced up to 1943

60 cm: (Karl): about 7 weapons produced up to 1942, self-propelling carriage, range with light projectile approximatly 8 km, with heavy projectiles approximately 6 km.

The special calibers with little demand on the barrel nevertheless were costly from the standpoint of manufacture. For this reason the production figures were relatively low. The objectives to be accomplished by these special calibers partly moved more and more toward the aerial bomb of the Air Force. About 1942 these calibers moved into the background. The railway guns - available in various types - were too hard to camouflage and outmoded, anyway, in this age of the rocket.

The milliped (Tausendfuessler) - which the Army Ordnance Office was forced to develop through influence on the part of non-military authorities with the Supreme Command, of the Armed Forces, with a caliber of 21 cm, a 120 m long barrel, not traversable, excessive powder charge at the bottom and from the sides, did not attain the expected range of 120 km.

cc) Mortars

The production of the 5 cm mortar was stopped beginning 1940, in its place the rifle grenade was demanded and introduced in 1940.

8.1 cm. mortar: Production approximately 300 per month. Increased production would have been possible (about 2,000 per month), was limited however by ammunition which in the long run would have consumed relatively much powder and explosives. The production, however, was increased to 2500 per month in 1944, in December 1944 the figure was even brought to 4500 (?). The Russian 8.1 cm mortars which had been captured had a different powder chamber, it was however possible to convert them for German ammunition.

In September 1941 the Army Ordnance Office applied for the construction of the well-liked Russian 12 cm mortars in imitation of the Russian type. Approval however was given only in the spring of 1942. It was necessary to increase the weight of the German base plate because the substitute materials used by the Russians could not be employed.

In the fall of 1944 a 21 cm mortar was demonstrated and introduced without the Army Ordnance Office taking a hand in the matter, the purpose being to make up for the loss of production in the matter of guns and to effect an economy with respect to the powder-heavy calibers.

In the beginning the test was a complete failure. Only with much effort and under conditions calling for the best on the part of the Army Ordnance Office and the industry was it possible to develop suitable ammunition and to make the mortar ready for commitment. It was given to the troops without adequate tests before hand, and under these circumstances the mortar was bound to disappoint.

dd) Rockets

Powder Rockets:

The 10 cm smoke shell mortar with a carriage that was too heavy, was in 1940/41 replaced by the 15 cm smoke shell mortar, the so-called sextuplet (6 barrels on one carriage) - ("Sechsling"). Noteworthy was the high explosive shell which had the propelling charge in the head of the projectile, with the result that the explosive charge located in the rearward part, exploded over the ground which was especially effective. For the 21 cm rocket projector (about beginning 1942) similar construction was not successful. Propelling charge and explosive charge extended over the entire length of the projectile.

The "heavy projector", caliber 28/32 cm (range approximately 4 km) on simple wooden mount for use in motion and in position required approximately 50 kg of explosives (as much as 42 cm shell for the guns), or of flame-thrower fuel, or other propelling agents to reach its target. The expectation to bring about extended area conflagration in this manner was not fulfilled.

The "Rheinbote", multistage rocket, with a range of 120 to 150 km, had greater dispersion. The development did not go beyond troop tests by 1945.

Liquid-Rocket

The V-2 was developed and tested in Peenemuende. The projectile was about 12 m long, with approximately 1 ton of explosive charge in the nose.

Propelling charge: alcohol (Spiritus) and oxygen, which, when flowing together, would explode. Enormous propelling power: electrical control was later in part replaced by mechanical control due to the danger of interference until the spring of 1942; the tests were confined to rockets of 1 and 1/2 tons. The V-2 with 25 tons was ready for commitment at the Front by the middle of 1944. Disadvantage arose in the matter of mass production since the interior of the projectile was in itself a complete laboratory which was not always safe in transport and sensitive to moisture. For the commitment in the field, special vehicles were constructed. A stationary installation with adequate protection against bombs (air raids) was blueprinted.

The originally expected range of 250 km was exceeded. For the bulk of the rounds the dispersion was about the same as that of long range, flat trajectory guns. For a while the numerous premature detonations over the target presented considerable difficulties. The opportunity for camouflage was good, the use was concieved as that of long range artillery.

The original demand was for 18,000 per month, a figure which was brought down to 900; as a matter of fact, not more than 400 a month were actually produced.

The development of liquid-rocket with 100 tons and considerably larger range did not go beyond the blueprint stage. On the other hand, the project of a V-2 with stub wings, took somewhat more practical forms.

ee) Range Finding and Laying Mechanism Sight Equipment

Direction finding equipment (temperature principle) for marine targets, especially for darkness and poor visibility,

Stereoscopic range finder 1.2 m, self adjusting, ~~n~~

Aiming circle kollimator and deflection kollimator, to save ammunition,

Remote object camera,

Many types of telescopic sights for guns, tanks and self-propelling gun carriages, Sun dials,

Infantry sound ranging equipment,

Meteorological equipment and equipment for sending weather reports,

Fire directing equipment for Division artillery for concentration of fire within a minimum of time. This sort of equipment required too much personnel and material; only 3 batteries were established,

Fire directing equipment for coastal batteries,

Firing plate for facilitating the placement of the first round,

Telescopic sight equipment for operations against tanks, automatic direction giver for armored observation vehicles; not yet quite satisfactory,

Fire directing equipment for armored observation vehicles, electrical night telescopic sight with ultra violet searchlight.

b) Ammunition

1. Armor Piercing Shells

aa) Steel armor piercing shells with especially blunt nose and weak bursting charge for guns with high muzzle velocity.

bb) Armor piercing shell 40 (Subcaliber with tungsten core)) See
cc) Hollow charge shells) H a, 5 aa.,

2. Fuzes

There were many different types of fuzes. The tests executed for the purpose of reducing their number did not give any satisfactory results.

3.) Bodies of Projectiles

An attempt to reduce the weight of the basic ~~barrels~~ projectile bodies was successful. In this manner a saving of approximately 2,000 tons of steel monthly was effected for the light field Howitzer shell. By improving the quality of the Bessemer steel, it was possible to use this steel with resultant economy of the Siemens-Martin steel. Furthermore, the founding of steel projectiles was simplified in many respects.

About 1943 it became possible to build bodies of projectiles which at the same time could be filled with explosive and chemical warfare agents; until then special bodies had to be held available for explosives and for the various chemical warfare agents.

4.) Powder

The life of the barrels was considerably prolonged through the use of cold powder.

Efforts at eliminating muzzle flash and smoke were not successful. It was never possible to accomplish more than the elimination of one or the other. Moreover, there existed too many different types of powder. Even for the assault gun a special powder had to be made.

5.) Explosives

Trinitrotoluol, Hexogen and Nitropenta with detonation velocities of 5 (6?) thousand, 7,000 and 8,000 m/sec.

As a result of the scarcity of raw materials, substitute ways were found to maintain the effectiveness of the explosives by the addition of available substances or, at least, to reduce the effectiveness but little. The same was true for powder. It must be admitted that in this manner the period of time during which powder and explosives were useable was materially decreased (disintegration).

6.) Range Increase

It was a constant demand by the Front; attempt~~s were~~ [illegible] made to bring it about by :

aa) Supplemental charge and muzzle brake (for light field Howitzer and heavy field Howitzer about 1942).

bb) Projectile with accelerating agent added through jet (this however produced increased deflection dispersion); the muzzle brake was a retarding factor.

cc) Special forms for projectiles somewhat corresponding to the C-projectile of the First World War.

dd) The Peenemuende arrow projectile and wing-stabilized projectiles. Arrow-shaped projectile. K-5 (28 cm, normal range 56 km) attained for example approximately 90 km. The wings would unfold after the projectile had left the barrel.

ee) The "cone": addition of a conical elongating piece to the barrel with subcaliber projectile. The tests in this direction had not as yet been satisfactory.

ff) Subcaliber projectiles, for which the rotating bands would remain on the projectile, for instance, armor piercing shell 40, or they would drop off after the projectile had left the barrel, for instance, K-5 (at the same time with the form of the Peenemuende arrow projectile) with a range of approximately 130 km or heavy field Howitzer with 15 km range.

7.) Increased penetration Power:

Especially long projectiles with wing-stabilization. Small range but very good penetrating power and high moral effect.

(3.7, 5 and 21 cm caliber, extensive tests only).

8.) Mass Production

"With the proper appraisal of the importance of ammunition production there was at the beginning of the war an immediate expansion; it was to become evident very soon however that Germany was in no ways prepared for the requirements for such a war." Extensive preparations on paper had been made but there was a lack of tools, instructions, drawings, material, means of operation, instructions for the manufacture of test material, the latter having been issued in relatively small numbers; since no offical announcement had been made of the mobilization, the result was that the production geared to peace-time continued and that the factories were not available for the production of ammunition. The most urgent dndeavors on the part of the Army Ordnance Office to increase the production of ammunition could under the circumstances not accomplish the desired results. These facts with respect to the production of ammunition surely played a part later in inducing the Supreme~~m~~ Command of the Armed Forces to create the Office of The Reichsminister for Ballistics and Ammunition. He even brought out primary production figures among which the requirement for 5 million rounds of light field Howitzer ammunition per month was the most striking. To reach this figure, in addition to the figures for other types of ammunition, was impossible. This impossibility being again and again emphasized by all the experts concerned. At times, the Supreme Command of the Armed Forces could be induced to reduce the above figure to 3 million, but sooner or later the original requirement of 5 million rounds of light field Howitzer ammunition was reestablished.

The increase in the production of ammunition was effected up to the middle of 1940 under the greatest difficulties; on the other hand, the successful campaigns in Poland and France were conducted within the limits of available ammunition; after the campaign in France the infamous order by the

Supreme Commander of the Armed Forces was given, calling for a slow-down in the production of ammunition, an order which the instructions on the part of the Reichsminister for Ballistics and Ammunition only tended to make all the sharper. This slow-down in the production of ammunition was brought about in the face of resistence on the part of the Army Ordnance Office and of warnings from the industry. Numerous orders were withdrawn from a number of factories, the building of new plants was stopped and the orders to be filled by the latter transferred to other manufacturers. Orders for production machinery were cancelled, workers migrated to other industries by the tens of thousands, there were even orders to scrap basic barrels (Rohlinge).

After the turmoil lasted from 4 to 6 weeks in the aforementioned ammunition industry, the orders calling for slow-down were relaxed but, on principle, they remained in effect.

Owing to the operations by the enemy air force against the German Motherland there arose suddenly an enormous demand for antiaircraft ammunition. The production of time fuzes which had begun well enough, represented a bottleneck; this production had previously been slowed down and now had to be suddenly increased once more. With tremendous efforts, on the part of the Reichsminister for Ballistics and Ammunition, especially, it was possible to attain within a period of one and one-half years a production of 2 million per month which figure was maintained to the very end of the war owing to the bad experiences gained, with the result that the time fuzes as against other phases of antiaircraft ammunition were produced in the amount of 20 million.

The grotesqueness of the slow-down in the fall of 1941 is illustrated by the fact that in December 1941 only about 90,000 rounds and 49,000 rounds for the light and the heavy field Howitzers, respectively, were produced. In spite of all presentations on the part of the Army Ordnance Office and other services, the Reichsminister for Ballistics and Ammunition took no steps to ameliorate the situation, or what steps he took were not effective.

Only under the new Reichsminister for Ballistics and Ammunition, who had an eye for half measures, did conditions improve. Within a few months it was possible to bring the light field Howitzer production to more than 2 million which figure was later increased to 3 million. But, as so often, the caption for this particular chapter was "too late."

"Within the scope of the disastrous orders issuing from the Supreme Command, the production of infantry ammunition holds a special place. The new Reichsminister for Ballistics and Ammunition, upon taking office, let the production of infantry ammunition run at 50 million per month. Only in 1943 was the importance of this phase of production recognized with the result that plans were made to increase it to 750 million; although experts were called in and chiefs appointed the progress was slow due to the difficulties in the procurement of skilled workers, to scarcity of material. Here, too, all measures taken were characterized by a lack of foresight, by the wrong evaluation of the over-all situation, by over estimating the capacity of the German industry in the matter of conversion. Whenever the results were bad, due to industrial difficulties, the leading authorities were of the opinion that the cause lay with the chiefs and the managers. /The belief in strong men, activists, never permitted a clear picture of the real difficulties to come into focus. New experts, new chiefs, were appointed. The turmoil in the instructions issued by authorized persons often tended to increase the difficulties which lay in the nature of things. The idea, predicated upon the value of personalities who carried others along, was basically correct but it was frequently deceptive and tended to befog the actual facts.

The principle to ask for the impossible in order to accomplish the possible was overworked and had grown dull.

In spite of all these retarding factors, which found expression in wrong dispositions and were especially noticeable in the field of ammunition production, the accomplishments of the German industry in the opinion of the Army Ordnance Office were extraordinary. "Every man from the manufacturer, the engineer, down to the lowliest worker, did his duty untiringly. Brought into a war for which the German people had not worked and which the German people never had wanted, every man considered it his so-called "damned duty and responsibility" to give his best. There were plants where the foremen had placed their beds near the hydraulic presses which were needed for the production of shells, so that they could be ready at any time to give a helping hand. In spite of the food situation which was becoming steadily worse, in spite of all the suffering caused by round the clock air raids, in spite of the long distances between homes and places of work - often amounting to 20 to 30 km - the accomplishments of the German workers were nothing short of astounding. Equally admirable was the readiness on the part of foreign labor to help in the ammunitions industry, where Frenchmen, due to their dexterity, were predominantly employed as specially skilled workers, while the Poles and the Russians were well liked for their willingness and their industry. A few figures may be set forth for purposes of comparison:

"In the First World War (according to the book by Professor Weyrauch, Stuttgart) the maximum figures per month attained in the production of ammunition were:

in steel 240,000 tons;
in high-value explosives (Trinitrotoluol and others) 8,000 tons;
in powder (including substitute powder) 14,000 tons;
production of infantry ammunition-the monthly capacity in one instance during the Hindenburg program, 270,000 rounds.

In the Second World War:
450,000 tons/month of steel;
25,000 tons/month high-value explosives;
25,000 tons/month of powder (not including substitutes)

for infantry ammunition a monthly maximum of 450 millions was attained. The over-all maximum of ammunition production was reached in October 1944, after which time it dropped with surprising rapidity due to the air raids by the enemy."

c.) Motorization and Tanks

Motorization

The production of motor vehicles suffered from the fact that the standardization in the field of motor vehicles was not brought about in time. Efforts on the part of the Army Ordnance Office had been made in that direction for a long time. Moreover, the conversion of already existing plants to uniform types required an unreasonably long time. As an illustration, with the conversion of a factory belonging to a first-rate concern, to the three-ton Opel, there was no production whatsoever for a period of one year. And the standardized production of the same truck type by the various Ford plants in Western Europe never amounted to anything.

The requirements in the matter of terrain maneuverability in the East, particularly during the muddy season, were unusually high. Four-wheel drive, chains on the rear wheels of trucks, were not enough. Besides the time proven excellent prime movers (four types) the peoples' car and the half-track motorcycle proved serviceable.

Tanks, Tank Artillery and Assault Guns

On September 1, 1939 the tanks I, II, III and IV and two types created by the Czech Army were ready for commitment.

The insufficient armament soon eliminated tank I with its two machine guns and tank II with its ~~two~~2 cm gun, and this lack of penetrating power resulted in constant changes of tanks III and IV, from short to long barrels, from 5 cm caliber to 7.5 cm guns with long barrels (50 caliber lengths) which was excellent in operations against T-34, but which was not certain of being effective against the type Stalin. To afford added protection for the crew, the armor was constantly being made stronger and "aprons" (Schuerzen) against magnetic charges were provided. In this manner, the combat weight of the tanks III and IV was increased approximately to 26 tons. With respect to the motor and the running gear, these types were built for 18 tons; as a result, the vehicles were made slower and suffered frequent failures of the running gear".

"The current production of tanks II and of a small portion of tank III was converted to self-propelling carriage with lateral protection against fragmentation for the artillery of the Armored Divisions and rendered good service with light and heavy field Howitzer, even though the traverse of the piece in position was limited." Moreover, the Armored Artillery (Tank Artillery) required improved equipment, as far as observations vehicles were concerned.

Assault guns (in tanks III/IV without "cupola"(Kuppel)) in the beginning had only 7.5 cm gun, later light field Howitzer 18 as a supplement to the battery; they proved their value. The lack of traverse was compensated for by moving the carriage and by the fact that the superstructure was kept lower with the result that the piece offered but a small target.

"From a standpoint of production the firms engaged in the manufacture of the tanks, including the other plants furnishing motors, gears, chains and armor sheet steel, were in 1942 equipped for the production of approximately 300 units of all types. Since the firms for tank II were practically kept busy with deliveries to the Artillery, and since the assault gun in tanks III/IV went to the Infantry, there remained for the armored regiments a production

This new type was to have a specially constructed motor and a new type of electrodynamic propulsion. The time available for thorough construction and tests was too short so that ultimately the tanks which had been provided for the purpose were produced as assault guns with 8.8 cm guns (approximately 90 of them(Ferdinand)) being hastily equipped with Maybach motors of the tank III.

"Ferdinand and Panther (likewise about 100 of the latter) were supposed to be ready for the offensive at Orel in the beginning of 1943. Upon being committed, they didn't satisfy because their hasty development and production resulted in too many failures. The production of the type Ferdinand was stopped, the Panther was improved and continued in production until the end of the war."

The surprise appearance of T-34 and the concern that even more strongly armored enemy tanks might make their appearance, had by 1943 resulted in the following armament:

Tanks III/IV - 7.5 cm gun, caliber length 50
Assault Gun(self-propelled(III/IV - 7.5 cm. gun, caliber length 70
Assault Gun III/IV - 10.5 cm Howitzer
Tank V Panther - 7.5 cm gun, caliber length 70
Assault gun Tank V - 8.8 cm gun
Tank VI (II) Royal Tiger
(Koenigstiger) - 8.8 cm gun
Assault Gun Tank VI - 12.8 cm gun
Tiger I: vertical, Tiger II:
(Koenigstiger)inclined sides. -

"Five each of the first Tigers (I) were committed in Tunis and in the East and foundered, especially because of the fact that there was no time to await the necessary equipment with reference to replacement parts and essential accessories. The Panther (approximately 50 tons) and the Tiger (approximately 75 tons) called for new, stronger cranes in the shops ~~and~~ new railway cars which it was possible to provide in time. (Type SS ym S). Both tanks had the newly developed 750 hp Maybach motor."

"The considerable increase in production nevertheless was characterized by a disregard on the part of the Reichsminister for Ballistics and Ammunition for the requirements of spare parts. It was difficult to conceive the extent of losses incurred over the long transportation distances and in the course of combat activities; equally difficult to conceive was the vast amount of material lying dead in the supply depots of the Army; the estimated depreciation of vehicles was held as low as possible so that in the matter of the production of new equipment the demands of the Reichsminister for Ballistics and Ammunition could be met and impressive production figures could be submitted to the high authorities. Here was an instance where the military conceptions of the Army Ordnance Office failed to conform to the ideas of the Reichsminister for Ballistics and Ammunition."

The development of a very heavy type (Maus)- (120-200 tons) with 15 cm gun did not go beyond tests with an experimental vehicle in Kummersdorf.

"The division of Operational Functions among a crew of five ~~persons~~ which had established its merit ever since 1933, was continued for both Panther and Tiger. As against the T-34 with a crew of 4, this called for greater space and higher weight, but has decided advantages tactically speaking.

"The matter of equipping the tanks with ultra violet searchlights (Uhu) for the operation of sighting mechanisms at night - in the beginning only a matter of troop tests - has remained problematical, the same goes for gyro stabilization for weapons to be fired while in motion, the Sealing of the vehicle for operations under water, the high pressure device as a means of protection against gas and the installation forward of mine detecting equipment.

d.) Equipment for Engineers, Railroad Engineers and Fortifications

1.) Mines

2.) Engineering machinery

3.) Bridge building and cable transport equipment

4.) Landing equipment

5.) Fortification equipment

6.) Not concluded developments

1.) Mines

aa) Antitank mines, see III, a-5, bb.;

bb) S-(shrapnel) mines - they proved themselves throughout;

cc) In operations against tank (armored) cupolas hollow charges were attached with little space in between and were used with a penetrating effect up to about 50 cm (for example, Fort Eben, Emaoel May 1940).

dd) Electrical mine detecting equipment.

2. Engineering Machinery

Pile driving equipment (lift through explosion) SZ 500 (kg) and 1200 (kg), with significance at the same time for construction industry, was ready for procurement by the end of 1942.

3.) Bridge Building Equipment and Cable Transportation

Bridge Building Equipment:

aa) B (16-24 tons capacity (Tr), pontoons including motor boats) proven combat bridge building equipment was produced at the beginning of an during the war in quantities varying from 2 to 6 units.

bb) K (30 ton capacity), obsolete.

cc) G (8 tons capacity), light wire cable bridge for mountain troops; introduced during the war.

dd) I (80 ton capacity, pontoons consisting of several parts) readiness for procurement was accomplished simultaneously with that of tanks, the constant change in the weight of the tanks during the developmental period notwithstanding. Total number of units delivered: about 9.

ee) Road and railway bridges which can be disassembled: Light (80 ton capacity), medium (cppacity: truck columns), heavy (capacity: truck columns N and E) with spans of up to 52.5 m, 45 m, and 110-136 (E) for the light, the medium and the heavy equipment, respectively. Light and heavy pillar equipment for long spans.

ff) Cable suspension bridge, a war-time railroad bridge with spans of up to 105 m, ~~and~~ making possible a saving from 20-40% in weight and construction time as against the systems used until then; this type of bridge which was also valuable for civilian use, was ready for procurement in 1944; experimental equipment was last being tested at Hegesee near Kummersdorf or in Stettin.

gg) For purposes of bridging steep grade differences or terrain hard to negotiate cable transportation was used for short distances and overhand cable railways (standard type 250 kg capacity) for longer distances.

4.) Landing equipment

aa) In addition to small assault boats (1939) the large assault boat was introduced; a speedy craft for the landing of infantry with its heavy weapons. Ready for procurement about 1943.

bb) Large and small landing boats, capable of being transported by rail, which proved themselves in operations for coastal waters; ready for procurement beginning 1940.

cc) "The Sea Seppent: floating, landing bridge for the unloading of larger vessels along free coast lines.

5.) Fortification Equipment

Equipment for all kinds of fortified installations; ventilation - bringing in and taking out air.

As a means of defense against landing operations 1942/43: for guns: concrete embrasures and light rotating armored cupolas (approximately 12 cm thick) as means of protection against attacks from the air.

6.) Not Concluded Developments

aa) Induction fuzes against the detection of mines by means of electrical mine detecting equipment.

bb) Hollow armor plate: newly developed, combat bridge equipment of high capacity (closed pontoons).

e. Communication Equipment

1.) General
2.) Wire (telephone)
3.) Radio
4.) Reconnaissance
5.) Fixed equipment and equipment for fortification communication.

1.) General

Army Ordnance 7 was especially created in the field of communication equipment, bringing its suggestions to the attention of Weapon Inspection and General Staff for the purpose of availing technical development for military use. In spite of the eminent position of the large Berlin electrical concerns, the assistance of medium size and small electrical firms was secured throughout the country.

The continued technical development which during the war often moved spasmodically and far exceeded the speed of peace-time developments could not always be realized actually, owing to the lack of capacity in many fields.

This prevented many improvements from being translated into gain before the end of the war.

Especially stringest, protective measures were taken for the construction of secret communication equipment (ciphering devices, secret additions to cryptographic equipment).

The mass production was until summer/fall 1944 generally adequate to the reasonable demands for essential equipment. In the beginning an obstacle was presented by the various parts of the Armed Forces competing for the services of the industrial concerns, a condition which beginning 1940 was essentially ameliorated by the Officer in Charge of Technical Communication Equipment (GBN). Furthermore, owing to the activities of that office, practical additional raw material needed for the communication equipment to be produced was gained from the discontinued and used-up equipment brought back to the industry; by virtue of this arrangement the somewhat tense situation prevailing in the field of materials for communication equipment was relieved.

2.) Telephone equipment.

The line equipment, that is, the light kind, soon fell into disuse; The heavy one-wire field cable, the double-paired long distance field cable of the troops and the field telephone, as well as the 10, 20 and 60 and the none-damping sender (for Supreme Command Armed Forces) - portable switchboard, proved their value throughout the entire war; same is true for the pertinent amplification equipment. At the very beginning of the war two types of teletype equipment could be introduced in time: the field teletype for tactical connections forward (Army) and the telegraph printer for the operative (strategic) teletype connections rearward. These two types likewise met all expectations during the entire war.

On the other hand, the bare wire (1.5 and 3 mm bronze), line construction with 4/8 lines was not safe enough and couldn't do the work, besides failing to keep up with the rapid speed of the advances in Poland and France; The repair of surface lines and long distance cables in the West did not produce the necessary results quickly enough. In the development of the rotating cross line (light poles, two wires with a constant change of position on the poles, multiple use with fourfold carrier frequency (TF.) and sixfold alternating current telegraph (WT) for the Armies and eight/fifteenfold TF. and 12/fold WT for groups of Armies and Supreme Command Armed Forces, the way out was found by Ordnance Proving 7 in 1940/41. Their construction was very rapid while the consumption of material was low, maintenance was simple, trouble shooting especially easy. The rotating cross axles have definitely proved their value. The later development of dual rotating cross axles with four wires yielded in excess of 40 phone/teletype connections. At the same time the carrier frequency increased distance to far over 1,000 km; in this manner the capacity of long distance cables was attained. An additional improvement was brought about in 1942 through the introduction of the very durable U-cable (Styroflex - wide tape cable).

Stretches which did not lend themselves to bare wire or cable connections were bridged by directed microwave radio so that they could be used for several phone or teletype channels. A prerequisite for these connections was optical visibility. After 1942 mobile directional connection equipment of this type was introduced which proved serviceable.

3.) Radio Equipment

The use of "ultra"-short waves in an attempt to satisfy the tactical requirements created the basis on which the radio equipment employed in the Poland campaign rendered excellent service, especially for the armored units.

"Radio technique had attained a high state ~~in~~ (mechanical reliability of the sets, stabilization and calibration, high selectivity of senders and receivers, suppression of the senders' upper waves, elimination of unfavorable short waves, extensive employment of ultra shortwaves above 5 m, distribution of the tactical tasks over the entire wave range from 5 m to 100 m, modal designation and standardization, simplified operation, resistence against weather influences) owing to all of these, the disruptions in the service were far less severe than anticipated. Short waves with considerable sky wave interference were properly recognized and avoided whenever possible."

"The types were changed only as the combat distances of the troops in the field and the operative distances became ever larger - (all of Europe and North Africa)".

"The complaints from the infantry and artillery about the heavy weight of their portable radio equipment were justified. For the elimination of this disadvantage the raw material situation presented difficulties, if for no other reason than that it was impossible to replace the heavy anode ("B")- batteries. Only toward the end of the war was it possible to bring out lightweight equipment with a rod battery for the infantry; the construction of sets for 1.5 to 3 m wave length at the beginning of the war had failed."

"The use of short waves for tactical long distance connection became necessary. For this reason the 200 and 800 watt set - 15 to 100 m with practically unlimited range, was introduced in place of the 1.5 kilowatt set, which was not serviceable due to the combination of short and medium waves. In spite of urgent representations, these types were not put into use as early as 1940, but only in 1941. The 15-watt set 152-100 m for medium distances did not work out."

"The Strategic radio development attained its peak with the radio teletype connection which worked with short waves, rhomboid antenna with directional effect, telegraph ~~print~~ printer with automatic coding and decoding and type printing - 25 letters per second; introduced in 1943."

"Beginning 1940 the Army Ordnance Office conducted short wave experiments Tripolis - Berlin - Doeberitz with observation stations in Norway."

By means of this development strategical radio equipment had been created which fulfilled all requirements.

"The curtailment of the development program in favor of production, chiefly owing to the pressure of the radio procurement program of the Air Force 1942/43, caused Germany to lose the lead in the field of "cm"-development. The conclusion of the development of the previously mentioned lightweight - smallest size radio equipment for the troops was so much delayed that the introduction of this equipment for the troops could not be effected in time."

4.) Reconnaissance Equipment

"Listening-in receivers were in existence, being extended to all known wave lengths at the beginning of the war. Special difficulties were presented by the short wave long distance direction finder, lesser difficulties by the "ultra"-short range direction finding; through introduction of the Goniometer-direction finder the long range direction finding was made efficient and the divergence between listening receivers and direction finding equipment sensitivity was eliminated. Construction extended to mechancial receiving equipment for special, rapid telegraphic, radio phototransmission and multiple communicating systems; tests were made with this equipment. All known secret telephone and technical secret telegraphy automatic systems were tested for their resistence to decoding and were decoded provided that they measured up to the latest mathematic-analytical standards. This brought about the recognition that the security of these technical systems did not so much depend on the technician as on the mathematician. The equipment for communication reconnaissance rendered excellent service."

"The greatest weakness of all technical communication connections lay in their susceptibility to interception. Protection against that is a matter of speaking, writing and sending discipline; it is at the same time a technical problem which during the war cannot be considered as having been solved as far as the telephone is concerned but which, with respect to the teletype, can very well be said to have been solved beginning 1942. An important discovery is that the cyphering machines and the supplemental cyphering equipment for teletype equipment were not safe against decyphering unless they were at all times incorporating the latest mathematic, analytical developments. These develpments were duly considered in the matter of improving the cyphering machine until the beginning of the war and for the introduction of the secret (G) supplemental equipment for the teletype in 1942 with the result that both can be said to have been safe against decyphering. For reasons of security it would appear practical to produce this sort of equipment in Army owned shops and not in private concerns.

"The problem of coding transmissions by the spoken word in order to safeguard telephone and radio communications against interception by the enemy, had been theoretically solved in a preliminary way by the end of the war, the development had begun after all systems of the enemy so far as they had become known by that time had been decoded."

5.) Fixed communication equipment and equipment for fortifications

The stationary radio receiving stations had been brought up to modern standards.

"The steel reinforced concrete of the fortification installations adversely affected, particularly, the radio communications of the troops, employing shortwaves and ultra shortwaves. For this reason, special antennas with nonradiating frequency feed were developed for Infantry and Artillery sets."

"The modulated, light ray communication set was put to good use. (Invisible infra red rays, duplexing, sharp bundling, to be blended with phone connections."

In summarization, it can be said that the technical communication equipment developed during this war for the German Army and used by the German Army in offensive, as well as in defensive, operations rendered excellent service.

f.) General Army - Medical and Veterinary Equipment

The rolling kitchens were continually being simplified throughout the war to effect a saving of raw materials and manpower.

The campaign in the East showed that the available types of sleighs were too heavy, and that runners for the wheels were not enough in the long run. On the basis of practical experiences, new sleighs were developed and produced during the summer. The finished sleighs and those in use in the Russian countryside frequently served as models. For guns special sleighs were produced which allowed the guns to be fired while in motion. The main difficulty lay in the fact that there were but a few months remaining between the time when the expressions of practical experiences were received and the time for shipment (September); these few months had to suffice for development and production at home of what had not been and was not geing produced at the Front.

In the field of medical equipment, special stretchers were developed and produced for carrying individual wounded in high mountain areas.

For horses a special type of nostril gas mask was developed and produced.

I. Experiences (The Lessons Learned)

Preliminary Observation: "The conclusion as to "what should have been" shall be drawn from the ex post facto vantage point of today, details to be expounded on the basis of principles.

I) "Principles governing the administration of the German war economy under conditions prevailing between 1938 and 1945:

a) The soldier, the economist and the technician should work together in matters of administration, planning and supervision.

b) The decisions to be made should ultimately be predicated upon those of the soldier with due regard for technical and economic potentials.

c) A high degree of individual responsibility and self-organization with the best possible regard for what had come to be "tradition."

d) Creation of production districts according to over-all groups of war equipment, for the purpose of speeding up traffic in all its ramifications.

e) The employment of the real leaders in the fields of economy and technique by the Armed Forces and in the intermediate positions of authority.

f) A stronger participation on the part of the war economy in the development of means of transportation and in the enlargement of transportation networks (in conjunction with d) through close cooperation with the military.

II) "In Detail:

Preliminary observation: Inasmuch as the thoughts to be expressed hereunder should be presented within a wider frame which the writer does not possess, it is established as a matter of basic principle that, in the light of conditions in Germany, the Army is the principle part of the Armed Forces, while Air Force and Navy should be given independence in clearly defined special fields only.

a) Administration:

The Army soldier plans, administers and supervises in cooperation with the Air Force and the Navy; these three work together with the economist and the technician (see Ia). The final decision rests with the Army soldier. The over-all plan which is to be developed must be kept within the realm of what is feasible. The Administration must establish the limitations for those charged with providing what is needed, so that the framework may provide a place for all.

Appen. VI and VII

b) Organization (see diagrams ~~#~~ for appendix VI and VII), an Army Ordnance office (somewhat corresponding to the Armed Forces Ordnance Office, chapter G) but with these differences:

1) A separate authority for the special weapons of Air Force and Navy.

2) Changing the Reichsminister for Armament and War Production to Reichsminister for War Economy (including Transportation) under the Supreme Commander of the Armed Forces, besides being under the Supreme Commander of the Army. In this setup the Reichsminister for War Economy would confine himself to mere administrative functions, with the Administration clearly and tightly organized.

3) Organization to be based on the various phases of war equipment production, an arrangement which is intended to forestall the dissipation usually attending war-time expansion; that is, an organization comprising

Proving,
Technical data (Chief Engineer),
Procurement,
Acceptance,

to be based then on composition (Laborierung), storing and readying for commitment ("Feldzeug-Meisterei"-Ordnance Service), on the responsibility of the troops for the Materiel delivered (Engineer Inspection), on the Chiefs of the Diagonal Services ("Querverbindungen") with adaption to the organization of the Reichsminister for Armament and War ~~Product~~ Production.

The best possible safeguards must be provided for the Administration to have a part in production-technical matters, the field of practical use, nevertheless, to be left to the responsibility of other authorities.

4) A High Degree of Decentralization

c) **Personnel:** see I e; concentration of technical personnel within the Army under an administration with both technical and military orientation (Army Ordnance Office).

d) **Location of Offices:** Their location to be adapted to existing "Production Districts".

e) Routine of Business to be directed at cooperation with "Liaison par le bas."

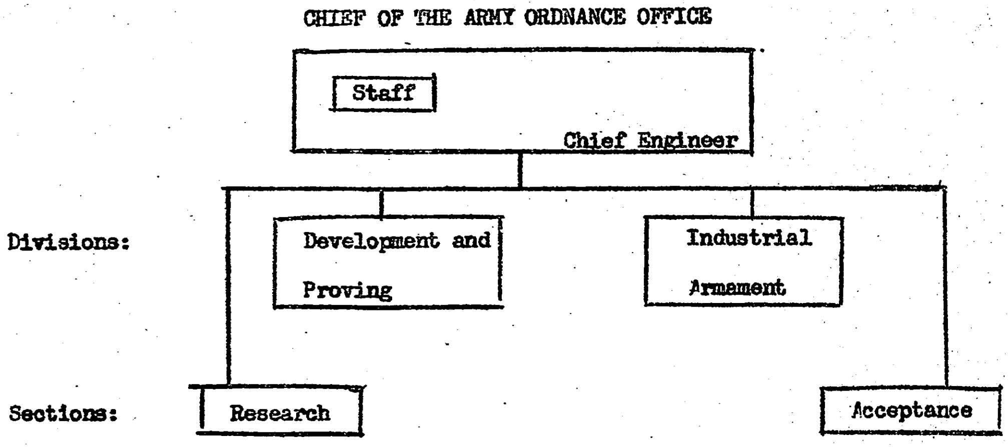
Emil Leeb

Supplement: After completion of this work the following document was received: "Statistics on the production of ammunition August 1939 to August 1940 (British Document M.I. 4/14 No. 690)". It lends itself to statistical compilations.

APPENDIX I:

ORGANIZATION OF THE ARMY ORDNANCE OFFICE

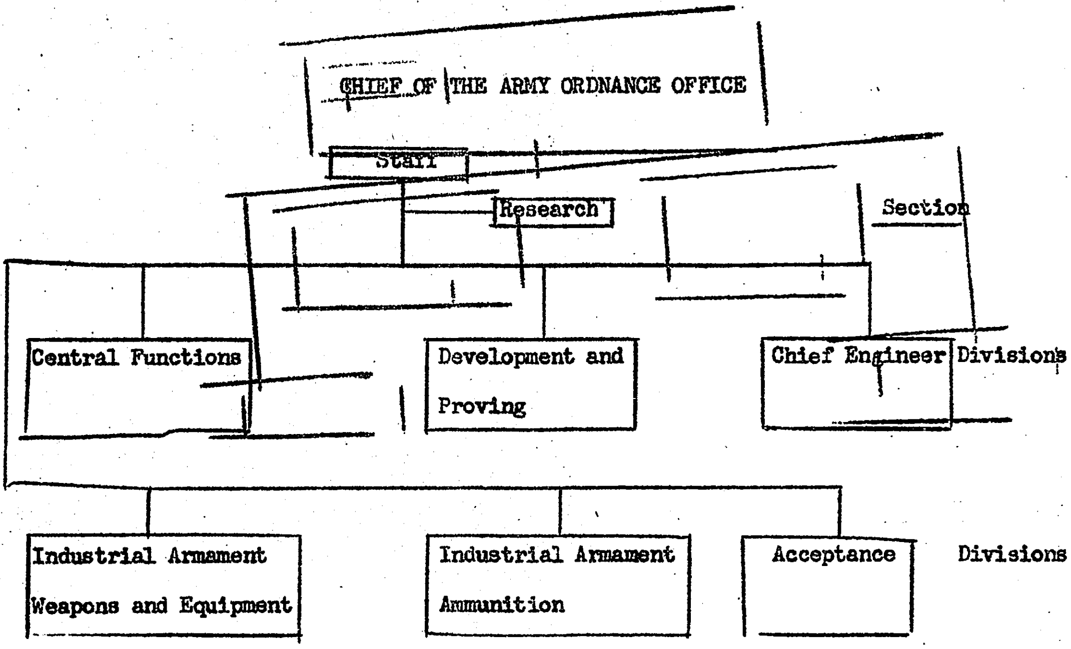
1938 to 6-30- 1940



APPENDIX II:

ORGANIZATION OF THE ARMY ORDNANCE OFFICE

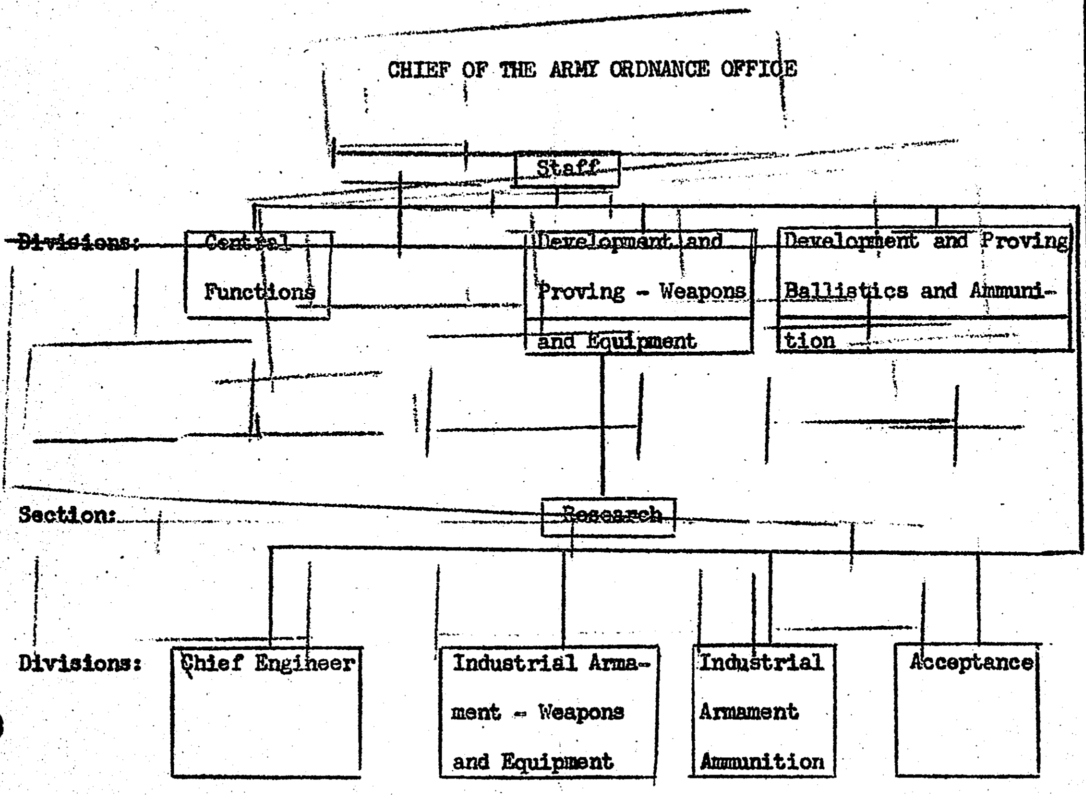
From 7-1-40 until 1944


CHIEF OF THE ARMY ORDNANCE OFFICE
Staff
Research
Section
Central Functions
Development and Proving
Chief Engineer
Divisions
Industrial Armament Weapons and Equipment
Industrial Armament Ammunition
Acceptance
Divisions

APPENDIX III:

ORGANIZATION OF THE ARMY ORDNANCE OFFICE

1944


CHIEF OF THE ARMY ORDNANCE OFFICE
Staff
Divisions:
Central Functions
Development and Proving - Weapons and Equipment
Development and Proving Ballistics and Ammunition
Section:
Research
Divisions:
Chief Engineer
Industrial Armament - Weapons and Equipment
Industrial Armament Ammunition
Acceptance

APPENDIX IV:

Breakdown of Divisions into Sections

Explanation: * Established) Breakdown according to
– Not Established) Appendix I to III

Designation and Scope of Division/Section	App.I	App.II	App.III	
Division Wa.Z. Important Central Functions	–	*	*	
Section Wa.Z. 1 Organization, Training, Liaison	–	*	*	
Section Wa.Z. 2 Contracts, Finance	–	*	*	
Section Wa.Z. 3 Montanindustrie G.m.b.H. and Plant Administration	–	*	–)	–) Taken over from Wa.Z. 2
Section Wa.Z. 4 Drawings, Production Information, technical Printing Regulations (Administration)	*)	*	*	*) from Ord. Proving
Section Wa.Z. 5 Critical Materials (Economy of Raw Materials	–	–	*	
Section Wa.Z. 6 Quarters and Matters of Air Raid Protection	–)	*	*	–) With Ord. Staff
Division Proving Development and Proving	*	*	*)	*) Weapons and Equipment Only
Section Proving 1 Ballistics and Ammunition	*	*	–)	–) With Ord.Proving under Ballis. & Ammunition
Section Proving 2 Infantry(small caliber weapons up to 2 cm)	*	*	*	
Section Proving 4 Artillery (large caliber weapons from 2 cm up)	*	*	*	
Section Proving 5 Mine and Engineer Equipt.	*	*	*)	*) Mines with Prov.1
Section Proving 6 Motor Vehicles & Tanks	*	*	*	

APPENDIX IV:

Designation and Scope of Division/Section	App. I	App. II	App. III	
Section Proving 7 Communition Equipment	*	*	*	
Section Proving 8 Optical, Observation & Ranging Equipment	*	*	*	
Section Proving 9 Gas Defense, Smoke and Chemical Warfare Agents	*	*	-)	-) Goes to Proving Ballis.&Ammun't'n
Section Proving Fortification	*	*	*	
Section Proving 11 Rockets	*	*	-)	-) Proving Ballis. & Ammunition
Section Proving 12 Proving Grounds	*	*	*	
Division, Proving, Ballistics &Ammun. Development and Proving for Ballistics and ammunition	-	-	*)	*) Beginning abt '43
Section Proving 1 Ammunition	-	-	*	
Section Proving 3 Ballistics	-	-	*)	*) From Proving 1
Section Proving 9 Gas Defense, Smoke & Chemical Warfare Agents	-	-	*	
Section Proving 10 Liquid-Rockets	-	-	*)	*) Beginning abt '43 from Prov. 11
Section Proving 11-Powder Rockets	-	-	*)	*) Beg. abt. '43
Division Ord. Chief Engineer Chief Enginerr	*	*	*	
Section Ch. Engr. 1 - Tech. Bases (Patents, Raw Materials, Standards, etc., Army Tech. Bureau)	*	*	*	
Section Ch. Engr. 2 Machines, devices, Instructions (Training)	*	*	-)	-) Goes to Reichsmnstr for Armament & War Production
Section Ch. Engr. 3 Halbzeuge and preparations for manufacture of these	*	*	*)	"Personal union" with armament and *) war production

APPENDIX IV:

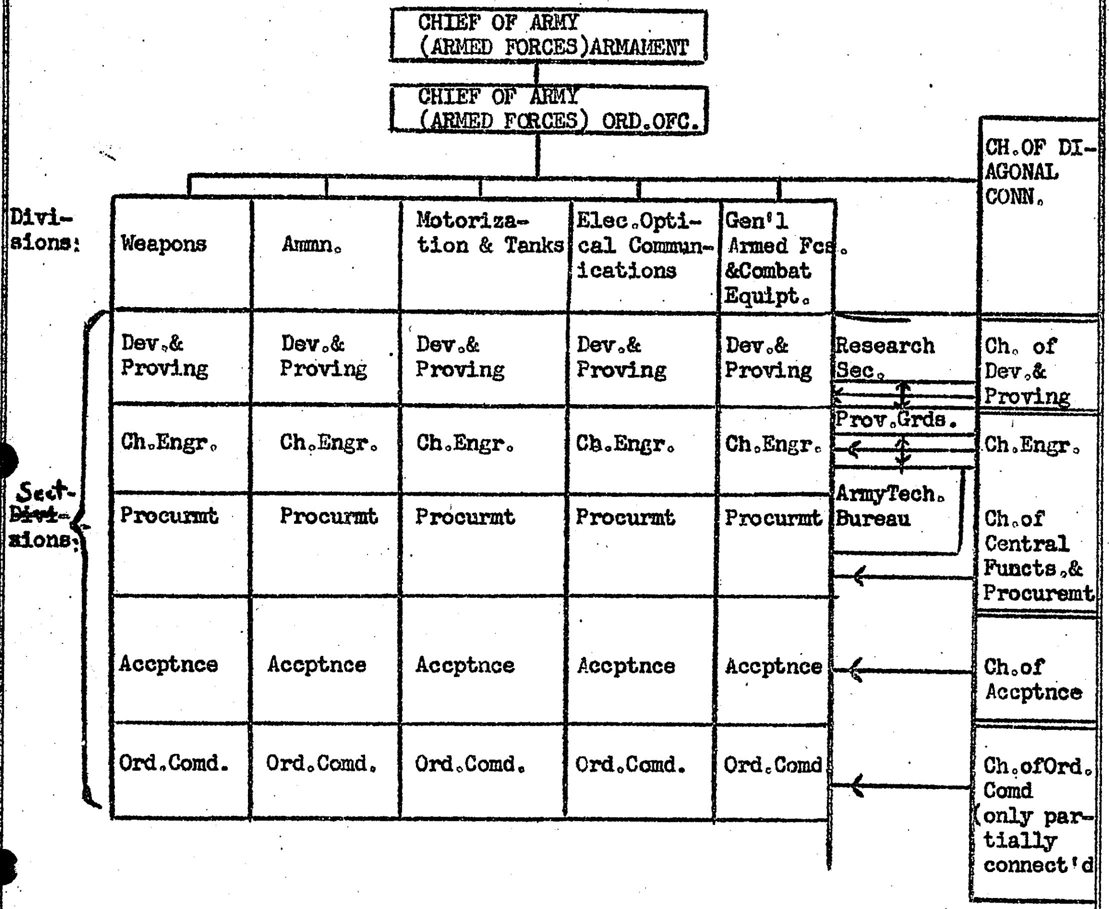
Designation and Scope of Division/Section	App. I	App. II	App. III	
Section Ch, Engr. 4 Preparations for Mfgr of Weapons & Equipment	-)	*	*	-) In div. Industrial Armament
Section Ch. Engr. 5 Preparations for Mfgr of Ammunition	-)	*	*	-) In Division Industrial Armament
Div. Ordnance Indus. Armament				
Industrial Armament	*)	-	-	*) Dissolved
Industrial Armament Staff Matters of Economy, Law & Finance	*	-)	-	-) Absorbed by Ord. Central Functions
Section Ind. Armament 1 General Army Transport Equipt & Gas Protective Equipt	*	-)	-	-) Weapons and Equipt. 1
Section Ind. Armament 2 Weapons & Optical Equipt	*	-)	-	-) Weapons and Equipt. 2
Section Ind. Armament 3 Ammunition	*	-)	-	-) Div. Ammn.
Section Ind. Armament 4 Preparation for Mfgr	*	-)	-	-) Ch. Engr. 4 and 5
Section Ind. Armament 5 Equipt. for Engrs, RR Engrs & Fortifications	*	-)	-	-) Weapons & Equipt. 5
Section Ind. Armament 6 Wheeled & Track-Laying Vehicles	*	-)	-	-) Weapons & Equipt. 6
Section Ind. Armament 7 Communications Equipt.	*	-)	-	-) Weapons & Equipt. 7
Section Ind. Armament 8 (Organization)	*	-	-	
Section Ind. Armament 9 Powder & Explosives	*	-)	-	-) Ammunition 3
Section Ind. Armament 10 Plant Adm.	*	-)	-	-) Ord. Central Functions 3
Divl Ord. Indus. Armament, Weapons & Equipt.				
Procurement of Weapons & Equipt.	-	*	*	
Section Weapons & Equipt. 1 General Army Transport Equipt. & Gas Protective Equipt.	*	*	*	
Section Weapons & Equipt. 4 Weapons & Optical Equipt.	*	*	*)	*) Without Optical Equipt.

APPENDIX IV:

Designation & Scope of Division/Section	App. I	App. II	App. III	
Section Weapons & Equipt. 5 Equipt. for Engr., RR Engrs. and Fortifications	*	*	*	
Section Weapons & Equipt. 6 Wheeled & Track Laying Vehicles	*	*	*)	*) Without wheeled vehicles beg. abt. '43
Section Weapons & Equipt. 7 Communication Equipt.	*	*	*	
Section Weapons & Equipt. 8 Optical Equipt.	-	-	-)	-) From Weapons & equipt 4 beg. abt. '43
Section Weapons & Equipt. 10 Liquid - Rockets	-	-	*)	*) Beg. about 1943
Section Weapons & Equipt. 12 Wheeled Vehicles-	*	-	*)	*) Beg. abt. '43 fr. Weap.& Equipt. 6
Division Ord. Indus. Armament Ammun. Procurement of Ammun.	-	*)	*	*) Fr.Ind.Armament 3
Sec. Ammun. 1-Bodies of Projectiles	-	*	*	
Sec. Ammun. 2-Fuzes	-	*	*	
Sec. Ammun. 3-Powder,Explosives & Primer Material	-	*	*	
Sec. Ammun. 4-Small caliber Ammun. & Cases	-	*	*	
Sec. Ammun. 5- Antitank	-	-	*)	*) Beg.abt.'42
Sec. Ammun. 6-Smoke & Chemical Warfare Agents	-	*)	*	*) Fr.Ammun. 3
Division Ord. Acceptance Acceptance of Weapons, Equipt, Ammun. & Test Material	*	*	*	
Sec. Accept. 1 Weapons & Equipt.	*	*	*	
Sec. Accept. 2 Ammunition	*	*	*	
Sec. Accept. 3 General & Test Material	*	*	*	

APEBENDIX V:

ARMY (ARMED FORCES) ORDNANCE OFFICE AFTER FEB. 15, 1945



CHIEF OF ARMY (ARMED FORCES)ARMAMENT

CHIEF OF ARMY (ARMED FORCES) ORD.OFC.

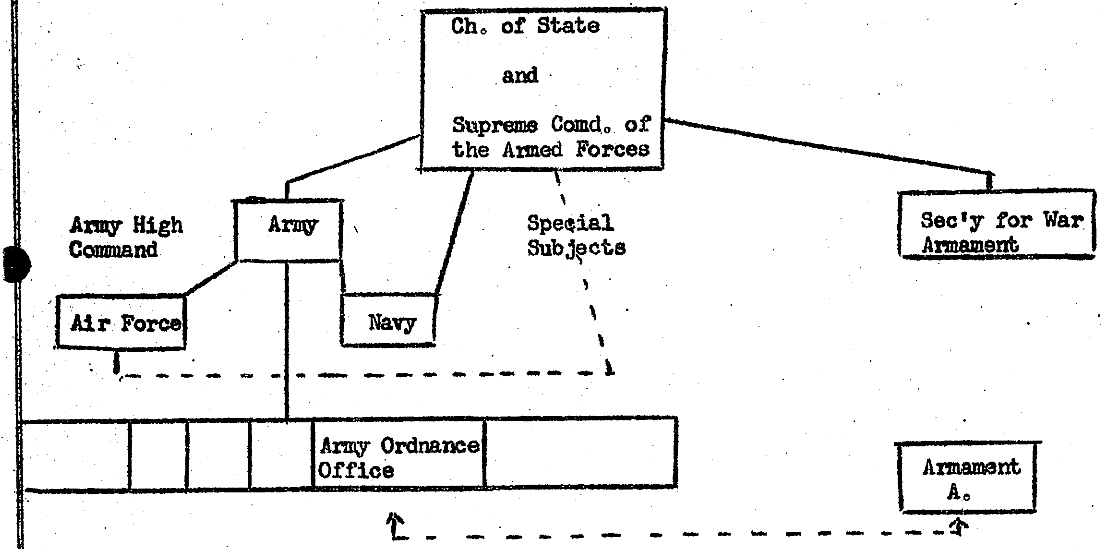
Divi-sions:	Weapons	Ammn.	Motoriza-tion & Tanks	Elec.Opti-cal Commun-ications	Gen'l Armed Fcs. &Combat Equipt.		CH.OF DI-AGONAL CONN.
Sect-~~Divi-~~sions:	Dev.& Proving	Dev.& Proving	Dev.& Proving	Dev.& Proving	Dev.& Proving	Research Sec.	Ch. of Dev.& Proving
	Ch.Engr.	Ch.Engr.	Ch.Engr.	Ch.Engr.	Ch.Engr.	Prov.Grds.	Ch.Engr.
	Procurmt	Procurmt	Procurmt	Procurmt	Procurmt	ArmyTech. Bureau	Ch.of Central Functs.& Procuremt
	Accptnce	Accptnce	Accptnce	Accptnce	Accptnce		Ch.of Accptnce
	Ord.Comd.	Ord.Comd.	Ord.Comd.	Ord.Comd.	Ord.Comd		Ch.ofOrd. Comd (only par-tially connect'd

APPENDIX VI:

PROPOSED TOP ORGANIZATION

(1939-1945)

FROM THE STANDPOINT OF THE ARMY ORDNANCE OFFICE

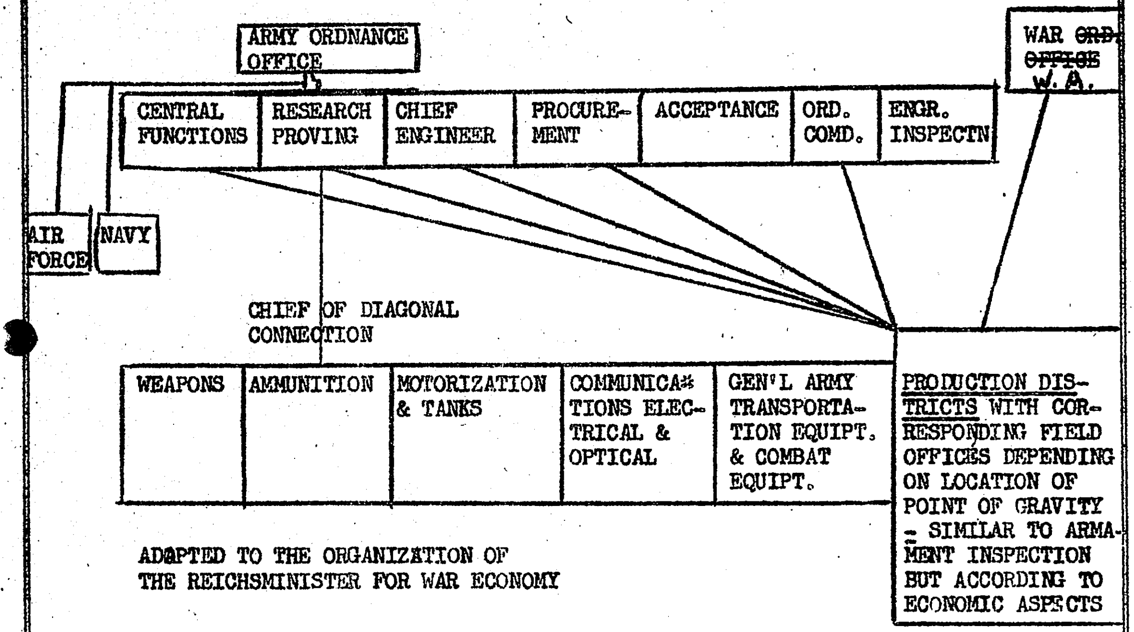


APPENDIX VII.

PROPOSED ORGANIZATION

(1939-1945)

AS ARMY (ARMED FORCES) ORDNANCE OFFICE


ARMY ORDNANCE OFFICE
WAR ~~ORD. OFFICE~~ W.A.
CENTRAL FUNCTIONS
RESEARCH PROVING
CHIEF ENGINEER
PROCURE- MENT
ACCEPTANCE
ORD. COMD.
ENGR. INSPECTN
AIR FORCE
NAVY
CHIEF OF DIAGONAL CONNECTION
WEAPONS
AMMUNITION
MOTORIZATION & TANKS
COMMUNICA- TIONS ELEC- TRICAL & OPTICAL
GEN'L ARMY TRANSPORTA- TION EQUIPT. & COMBAT EQUIPT.
PRODUCTION DIS- TRICTS WITH COR- RESPONDING FIELD OFFICES DEPENDING ON LOCATION OF POINT OF GRAVITY - SIMILAR TO ARMA- MENT INSPECTION BUT ACCORDING TO ECONOMIC ASPECTS

ADAPTED TO THE ORGANIZATION OF THE REICHSMINISTER FOR WAR ECONOMY

Table of Abbreviations

APPENDIX VIII.

A.

Abn.	Acceptance
Abt. Abtg.	Section
a.D.	Retired
A.H.A.	General Army Office

B.

B.f.L.	Representative for Capacity Increase
B.u.M.	Ballistics & Ammunition

C.

Chef H.Ruest.u.B.d.E.	Chief of Army Armament & Commander of Replacement Training Army
ChefIng.	Chief Engineer
cm	Centimeter
C T R	Chemical-Technical Reichs Institute ~~Dipl.Ing.~~

D.

Dip.Ing.	Engineer Graduate of Technical Institute (Academy)

E.

Eisb.	Railway

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F.

Fabrik.	Pertaining to manufacture
fabrikat.	Pertaining to manufacture
Flak.	Antiaircraft gun 43
Forsch.	Research

G.

G.(eheim)	Secret (confidential)
G.B.N.	Representative for Technical Communication Equipment
Ger.	Equipment
Gew.	Rifle
grosskal.	Large caliber

H.

H.T.B.	Army Technical Bureau
He.Wa.A.	Army Ordnance Office

I.

I.G.	Infantry Gun
I.Rue.	Industrial Armament
I.Rue.Mun.	Industrial Armament-Ammunition
I.Rue.W.u.G.	Industrial Armament-Weapons and Equipment

K.

K.	Gun
Kg.	Kilogram
Kleinkal	Small caliber
Km.	Kilometer
Komm.	Commission
Kpf.	Combat

L.

l.F.H.18	Light field Howitzer 1918

M.

m.	Meter
M.G.	Machine Gun
Min.	Ministerial
mm.	Milimeter
mon.	Monthly
M.P.	Submachine gun
Mun.	Ammunition

O.

Ob.D.H.	Supreme Commander of Army
Ob.~~d~~ d.W.	Supreme Commander of Armed Forces
O.K.H.	Army High Command
O,K.W.	Armed Forces High Command
opt.	Optical

P.

Pak.	Antitank gun
Patr.	Cartridge
Pion.	Engineers
Pruef.	Proving
Pz.	Tank

R.

Rmin.oder Rm.f.B.u.M.	Reichsminister for Armament and Ammunition
RMin.oder Rm.f.R.u.K.	Reichsminister for Armament and War Production

S.

s.F.H.	Heavy field Howitzer
s.I.G.	Heavy Infantry gun

T.

T.	Tank
T F	Carrier Frequency
to.	Tons
Tr.	Capacity
T 34	Russian Tank 34

U.

u.s.w.	And so forth

V.

V 0	Velocity zero, muzzle velocity

W.

W.	Weapons
Wa.	Ord. Office
Wa.A.	Ord. Office
Wa.Chef Ing.	Ord. Office, Division Ch. Engineer
Wa.Pruef.	Ordnance Office, Division for Development & Proving
Wa.Z.	Ordnance Office, Division for Central Functions
Wes.	Field
W T	Alternating Current telegraphy
W.u.G.	Weapons and Equipment

Z.

z.B.	For instance
z.Zt.	At the time

GS ID USA TRANSLATION	REGISTRY NUMBER	PAGE NUMBER
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Appendix IX.

Index of Names and Items

Arabic numerals refer to pages, Roman numerals to the Appendix where the alphabetically arranged names and items are to be found.

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